GAS

ENGINEERING • UTILIZATION • LOAD-BUILDING • MANAGEMENT

IT PAYS TO FEATURE ROBERTSHAW

FINGERS ON THE PUBLIC PULSE PROVE IT!

Smart merchandising men who "feel out" the public's taste know that women want their new ranges to be equipped with Robertshaw Oven-Heat-Control. That's why, in their retail ads, they feature ROBERTSHAW – picture ROBERTSHAW – headline ROBERTSHAW.

The clippings shown on this page show only a very few of the hundreds of retail store ads that play up the name.

If you *manufacture* gas ranges—remember how retail stores spotlight the Robertshaw-equipped product. If you *sell* gas ranges remember that the name ROBERTSHAW in your ads helps close many a sale.

ROBERTSHAW THERMOSTAT COMPANY · Youngwood, Penna.

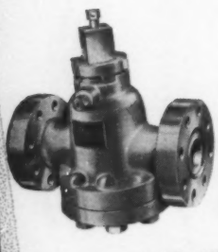
EMCO METERS AND REGULATORS NORDSTROM *Lubricated* PLUG VALVES

EMCO Domestic Gas Meters

Made in four types; the Standard, Curb Box, Tin and Ironclad. Each type is particularly qualified to fulfill the accurate measurement requirements of a specific domestic service. All are carefully constructed from the finest selected materials.

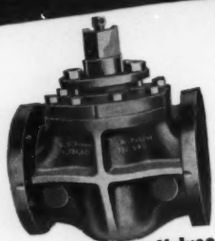
EMCO Large Capacity Pressed Steel Meters equipped with EMCORECTOR

The pressed steel construction makes an extremely strong, yet light and compact, meter for large capacity measurement. They have all the inherent simplicity and accurate measurement qualities of the well known EMCO line. Built in two sizes, having maximum capacities of 6,000 and 10,000 cu. ft. per hour respectively.



NORDSTROM Hypreseal Valves

Recommended for super valve service, particularly where high pressures and high temperatures are encountered. In the exclusive Hypreseal design no packing is required. No part of the actual plug is exposed to the atmosphere. No leakage can exist.



NORDSTROM Valves

In Nordstrom Valves the "Sealdport" method of valve lubrication forces Nordco Lubricant under high pressure between the plug and body, making the valve leak-resistant and freeing the plug to assure easy operation. Simply turning a screw at the top of the valve completely covers both seat and plug surfaces with a film of lubricant.

NORDSTROM Curb Service Valves

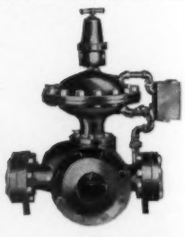
Eliminate service cock renewal expense. Patented "Sealdport" lubrication. No field adjustment. Gas pressure to 50-lb. Locknut ever-tight. Economically priced. No need to "use a hammer or monkey wrench" to open or close. Instant shut-off. Non-freezing. Non-sticking. Positive seal.

EMCO Large Capacity Meters Equipped with EMCORECTOR

Built for positive measurement of gas at high pressures. Removable valve plate mechanism enables quick repairs without removing meters from line. The EMCORECTOR, which may be fitted to any make of large capacity meter, automatically calculates and records to any given base pressure the volume of gas passing through the meter at higher pressures.

EMCO Appliance Regulators

Dependable pressure at the gas burners is assured with EMCO Appliance Regulators, spring or weight loaded type, regardless of volume variations and fluctuations in service line supply to domestic gas burning appliances, and also for commercial and industrial heating equipment units of all types.



EMCO Balanced Valve Regulators

Built for either high or low pressure regulation. EMCO Regulators have the exclusive removable and interchangeable valve bowl feature, which permits repairs to be made in the line with only a slight interruption in service.

Pilot Loading or Pilot Control Systems can be readily applied to EMCO Regulators.

CRAWFORD Sensitive Regulators

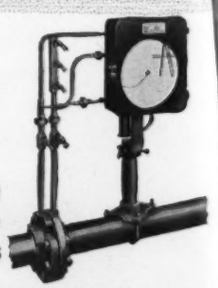
Designed to give extremely accurate outlet pressure control. Widely used on gas engines and for industrial installations and domestic services. Special applications, for which the Crawford's basic construction makes it ideal, include compressor unloaders and remote control tank regulators.

EMCO Field Regulators

Made in both Spring and Lever and Weight types. Especially designed for pipe line installations where a group of consumers are served directly from a high pressure transmission line or where a single customer must be served through a long serv ice line.

EMCO Ejector Service Regulators

Especially designed and built for domestic service and will operate under high or low pressure. Increased capacity and automatic loading with a marked decrease in pressure variations is made possible through the application of the ejector principle of flow control in the regulator valve chamber.



EMCO Orifice Meters

The design features of EMCO Orifice Meters include the use of stainless steel for all internal parts; entirely independent differential and static units; no angularity error; smooth, accurate differential movement obtained through the use of exceptionally large float; moisture-proof case and an all-welded steel manifold.

PITTSBURGH EQUITABLE METER COMPANY

MERCO NORDSTROM VALVE CO.

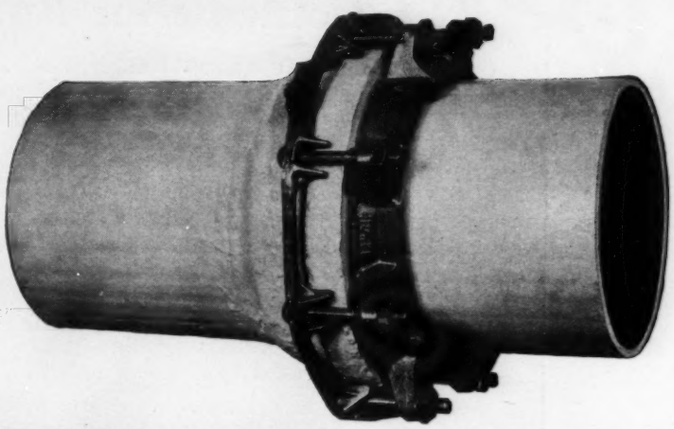
NEW YORK · BUFFALO · PHILADELPHIA
KANSAS CITY · TULSA · LOS ANGELES

Main Offices - PITTSBURGH, PA.

DES MOINES · CHICAGO · COLUMBIA
MEMPHIS · OAKLAND · HOUSTON

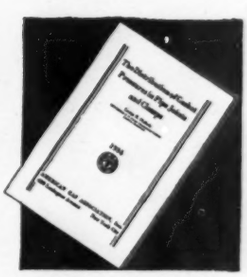
RESERVE

SEALING POWER—WHAT IS IT?



—AN EXTRA MARGIN OF SAFETY . . . SAFEGUARDING YOUR CLAMPING DOLLARS!

Dresser builds *Reserve Sealing Power* into bell-joint clamps for the same reason that bridges are built with safety factors! Result: no weak spots in gasket pressure at any point around the bell; greater sealing safety than you'll ever need—both today and to meet tomorrow's conditions. *Send for free booklet at right.* It tells how Dresser, through the use of an ingenious machine (the "Sealometer"), assures *Reserve Sealing Power* in every Dresser Bell-joint Clamp.



FREE! Send for booklet: "The Distribution of Gasket Pressures in Pipe Joints and Clamps."

RESERVE SEALING POWER . . . AND THESE EIGHT ADVANTAGES, TOO!

1. PERFECT ADJUSTABILITY

Follower ring has wide range of adjustment around spigot and an unbroken gasket recess.

Serrated ends on anchor-ring sections permit simple, effective adjustment around bell.

2. Quick and Easy Installation—without interrupting the service, using only a wrench.
3. High-Strength Malleable Iron—especially developed.
4. Balanced, Rugged Construction—providing ample strength at all points.
5. Complete Size Range—permitting standardization in all sizes.
6. Hundreds of Users—including 83% of the largest cities in America.
7. Built by Dresser—largest and oldest maker of bell-joint clamps.

8. CORRECT GASKET DESIGN

Large, specially compounded, condensate-proof gasket extends well up face of bell beyond calking and is confined so as to provide a pressure-tight seal, plus desirable flexibility in the joint. No protective parts are necessary.

DRESSER BELL-JOINT CLAMPS, Style 60

S. R. DRESSER MANUFACTURING COMPANY · BRADFORD, PA.

230 Park Avenue, New York, N. Y. · Peoples Gas Bldg., Chicago, Ill. · Shell Bldg., Houston, Texas

In Canada: Dresser Manufacturing Company, Limited, 60 Front Street, West, Toronto, Ontario

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Phone HARrison 8536

NEW YORK
Three Park Lane
Mt. Vernon, N. Y.

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"OUR HOT WATER'S NEVER FAILED US SINCE WE SWITCHED TO *Gas*"

CLEAN GAS MAKES SATISFIED CUSTOMERS

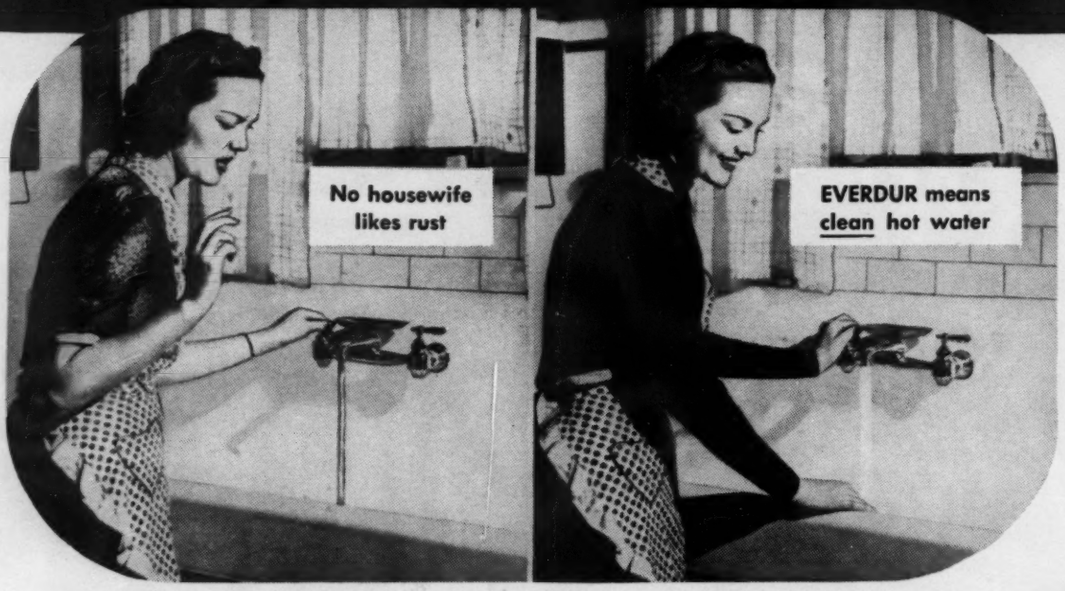
People set their standards high nowadays — in automobiles or household appliances they won't tolerate failure. More than ever your success depends upon your ability to keep Gas flowing through their burners — smoothly, silently, surely. That's a test only CLEAN Gas can meet, especially now that appliance apertures are smaller, mechanism more delicate.

So banish the chance of burner-clogging due to fuel . . . depend exclusively upon Blaw-Knox Gas Cleaners. Operating Engineers from coast to coast are doing that . . . and experience is showing them that "as GAS flows, demand grows".

BLAW-KNOX
GAS CLEANERS

BLAW-KNOX DIVISION OF BL... PITTSBURGH ...

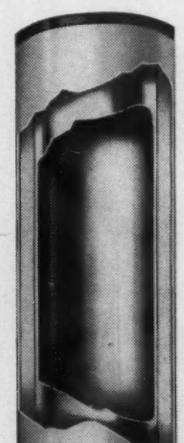
Frowns become smiles when the hot water tank is EVERDUR SILICON BRONZE



23 makers of automatic gas water heaters standardize on EVERDUR for non-rust models

FOR TANKS of non-rust heaters, specify Everdur, The American Brass Company's copper-silicon alloy. This metal is principally copper with controlled additions of silicon and other elements. It combines unusual resistance to corrosion, steel-like strength, and ready weldability, all of which are essential for durable water heater tanks. Welded Everdur tanks have successfully withstood every known test, and as a result are regarded as the most durable that can be used. That is why these 23 leading manufacturers standardize on Everdur for non-rust models.

Bastian-Morley Co., Inc.	La Porte, Ind.
Continental Water Heater Co., Ltd.	Los Angeles, Calif.
Crane Co.	Chicago, Ill.
Crown Water Heater Co.	Los Angeles, Calif.
Day and Night Water Heater Co., Ltd.	Monrovia, Calif.
EverHot Heater Company	Detroit, Mich.
Gas and Electric Heater Company	La Porte, Ind.
General Water Heater Corp.	Hollywood, Calif.
Handley Brown Heater Company	Jackson, Mich.
Hoffman Gas & Electric Heater Co.	Louisville, Ky.
Hotstream Heater Company	Cleveland, Ohio
Hoyt Heater Co. of Northern California, Ltd.	Oakland, Calif.
Lawson Manufacturing Co.	Pittsburgh, Pa.
Lovekin Water Heater Company	Philadelphia, Pa.
Merit Water Heater Co.	Compton, Calif.
Mission Water Heater Co.	Los Angeles, Calif.
Ruud Manufacturing Co.	Pittsburgh, Pa.
Sands Manufacturing Company	Cleveland, Ohio
F. O. Schoedinger	Columbus, Ohio
Southern Water Heater Corp.	Compton, Calif.
Superbo Water Heater Company	Los Angeles, Calif.
Welsbach Company	Gloucester City, N. J.
John Wood Mfg. Co., Inc., Conshohocken, Pa., and Chicago, Ill.	



Cutaway view of a modern water heater having tank of non-rust EVERDUR Metal.

ANACONDA

Everdur SILICON BRONZE

THE AMERICAN BRASS COMPANY, General Offices: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

EVERDUR is a trade-mark of The American Brass Company, registered in the United States Patent Office

3883

To add impetus to the architects' and builders' contest sponsored by the AMERICAN GAS ASSOCIATION, this advertisement appears in the March Contest Announcement Issue of the Architectural Forum.

TALK ABOUT ADAPTABILITY!

This is one of the outstanding features of NATIONAL SEAMLESS

One of ten points of Seamless superiority

YOU don't have to pamper NATIONAL Seamless Pipe, either while the job is in progress, or after the pipe is laid. And the reason is clear enough. For NATIONAL Seamless is far from ordinary pipe. It has, to a marked degree, that desired quality — ADAPTABILITY, a feature that facilitates handling, saves time and labor, and thus promises reliable installation. ADAPTABILITY is built into NATIONAL Seamless from the very start. The raw material that goes into its production must meet rigid specifications. Billets of highest quality steel, sound and flawless in every respect, are used for the piercing process, which, in itself, is convincing proof of the soundness of a seamless product. Every finished length of pipe must pass a series of critical tests and inspections, all giving further evidence that throughout every operation the product has been developed to meet every requirement in the field, including wide ADAPTABILITY.

Wherever pipe lines cross ravines and rivers, go around bends, or are subjected to other unusual strains in laying, you can depend on the time, labor, and money saving feature of ADAPTABILITY in NATIONAL Seamless.

No wonder pipe-line engineers have confidence in NATIONAL Seamless. No wonder there's a nation-wide trend toward this pipe for oil, gas, and gasoline lines. For it is METALLURGY'S NEAREST APPROACH TO THE PERFECT PIPE.

PART OF *Great Lakes Pipe Line Company's new construction program, consisting of several hundred miles of National Seamless. Here, ADAPTABILITY was an important consideration in its selection.*

NATIONAL TUBE COMPANY

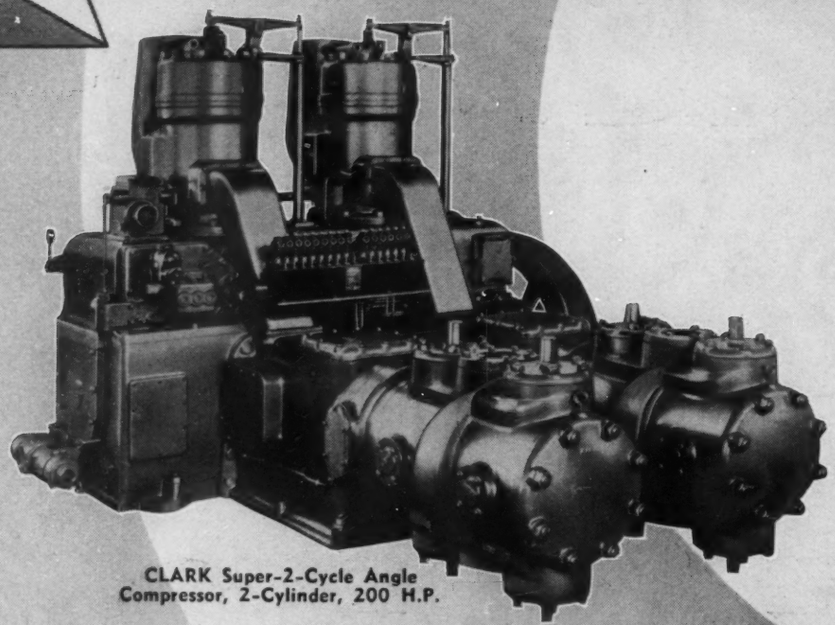
PITTSBURGH, PA.

United States Steel Products Company, New York, *Export Distributors*

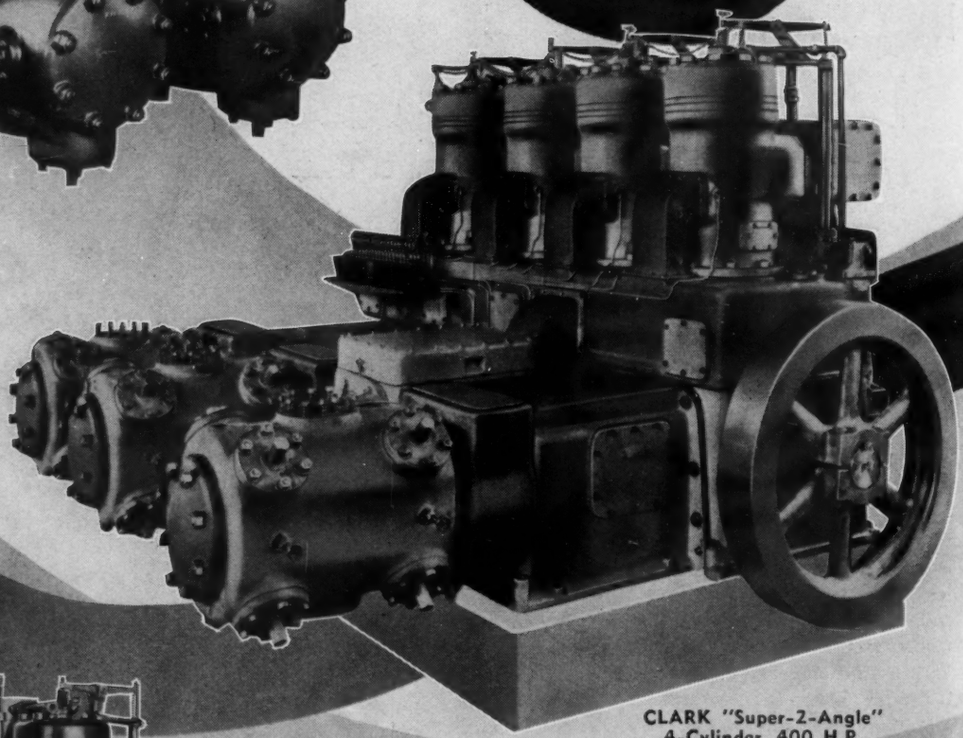
UNITED STATES STEEL

CLARK SUP

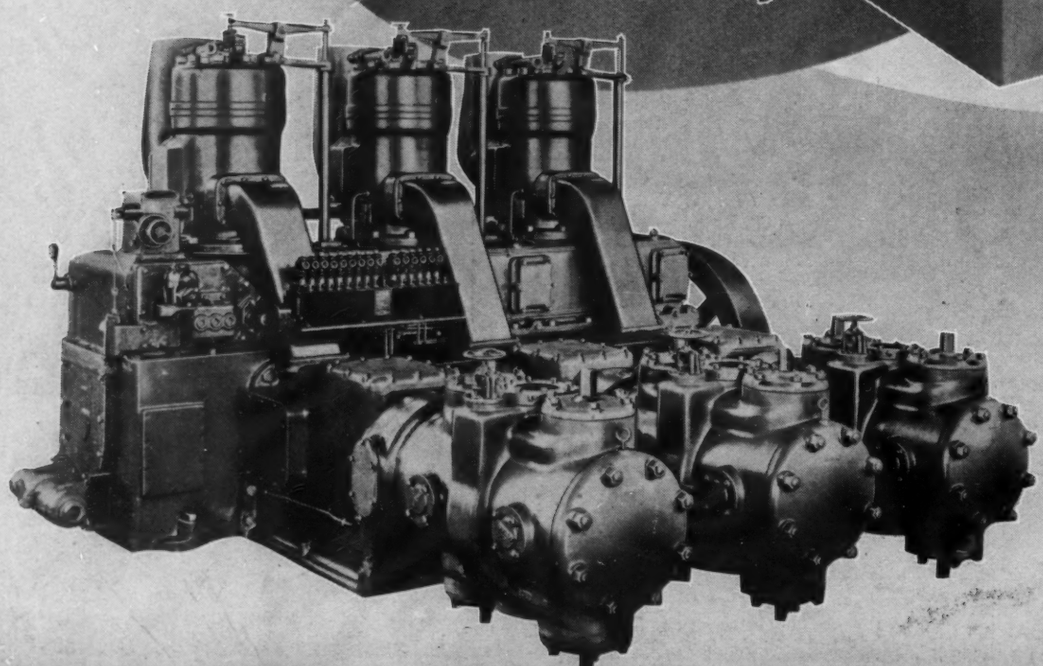
SUPER 2 ANGLE



CLARK Super-2-Cycle Angle
Compressor, 2-Cylinder, 200 H.P.

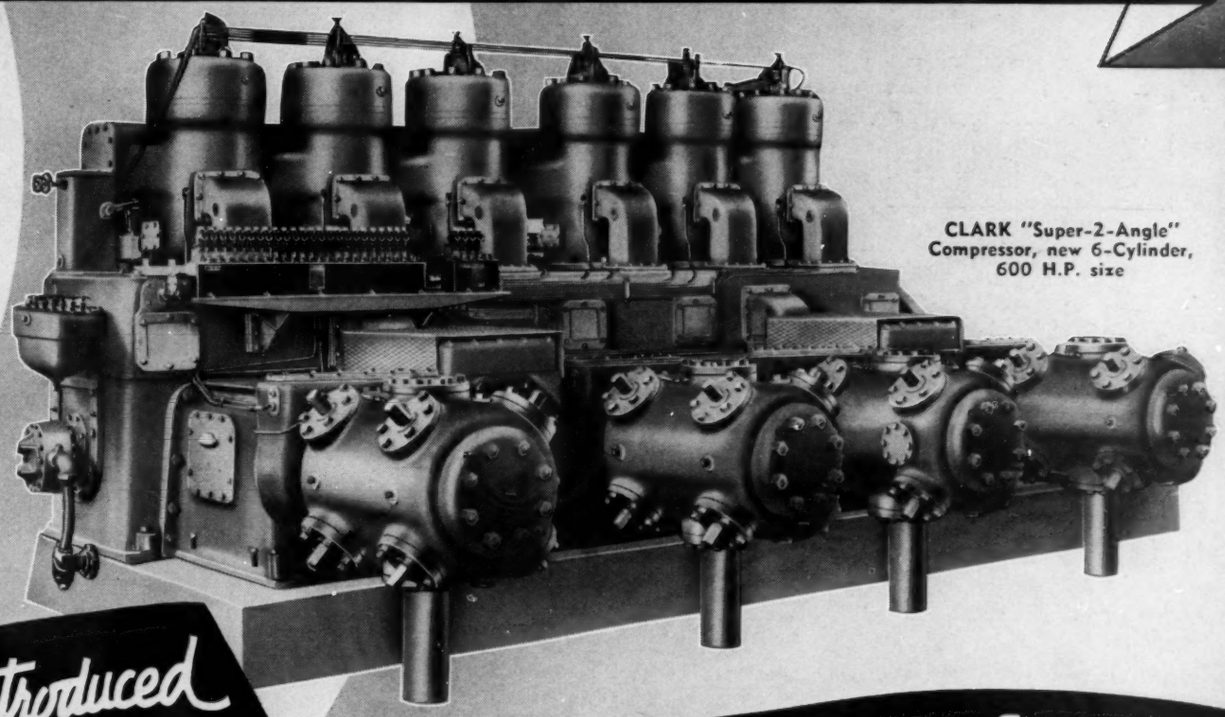


CLARK "Super-2-Angle"
4-Cylinder, 400 H.P.



CLARK "Super-2-Angle"
3-Cylinder, 300 H.P.

ER-2-ANGLES



CLARK "Super-2-Angle" Compressor, new 6-Cylinder, 600 H.P. size

Have Introduced 5 Important Savings!

The CLARK "Super-2-Angle" Compressor, introduced in May, 1936, has achieved a world success for a very simple reason. While possessing the same power and efficiency as the horizontal type compressor, it is more compact, thus effects several important savings, as follows:

1. SMALLER FLOOR SPACE AND BUILDINGS
2. SMALLER FOUNDATIONS, also due to compact right-angle design.
3. LOWER TRANSPORTATION AND ERECTION COSTS, because shipped assembled.
4. LOWER FUEL CONSUMPTION, due to CLARK Super-2-Cycle Fuel Injection.
5. LOWER MAINTENANCE EXPENSE, due to extreme simplicity of design.

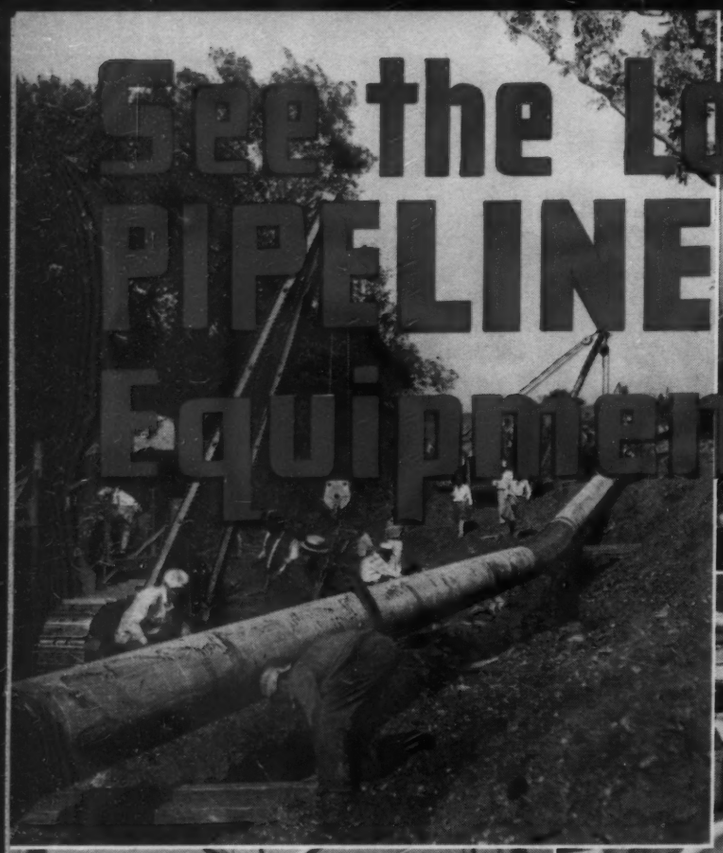
Leading oil and gas companies from coast to coast, and abroad, have made important installations, and are finding the CLARK "Super-2-Angle" a real money saver. Full particulars on request. Also

See CLARK Section, Composite Catalog

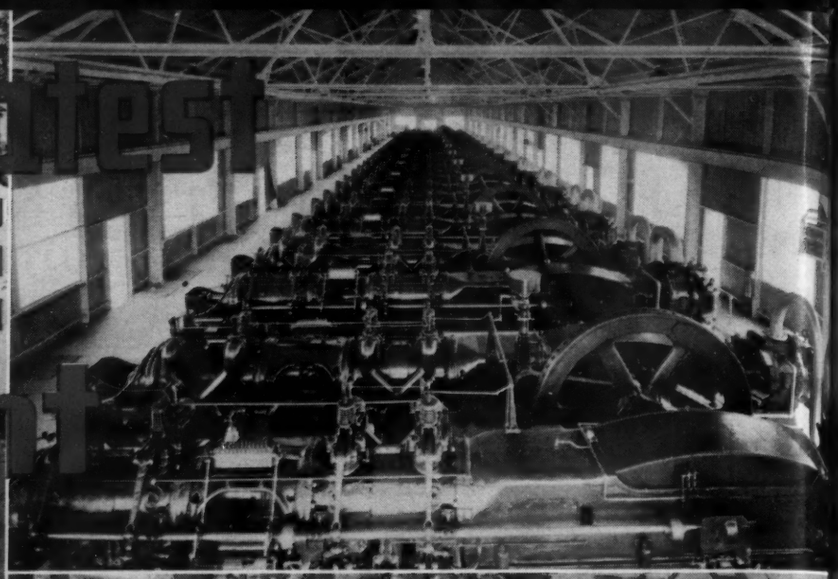
CLARK BROS. COMPANY . . OLEAN, NEW YORK, U.S.A.

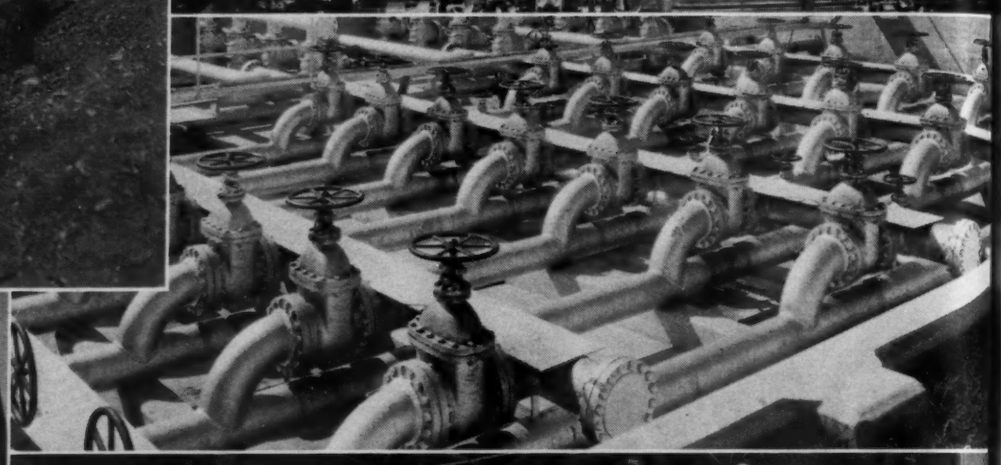
Export Office: 30 Rockefeller Plaza, New York. Midcontinent Sales Offices and Warehouses: Tulsa, Okla., Dallas and Houston, Texas. West Coast Office: Smith-Booth-Usher, 2001 Santa Fe Av., Los Angeles. Foreign Offices: 72 Turnmill St., E. C. 1, London, England; 4 Str. General Poetas, Bucharest, Roumania.

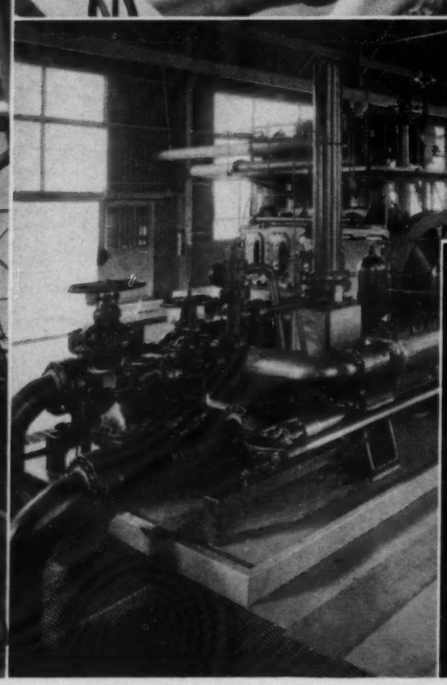
CLARK



See the Latest PIPELINE Equipment







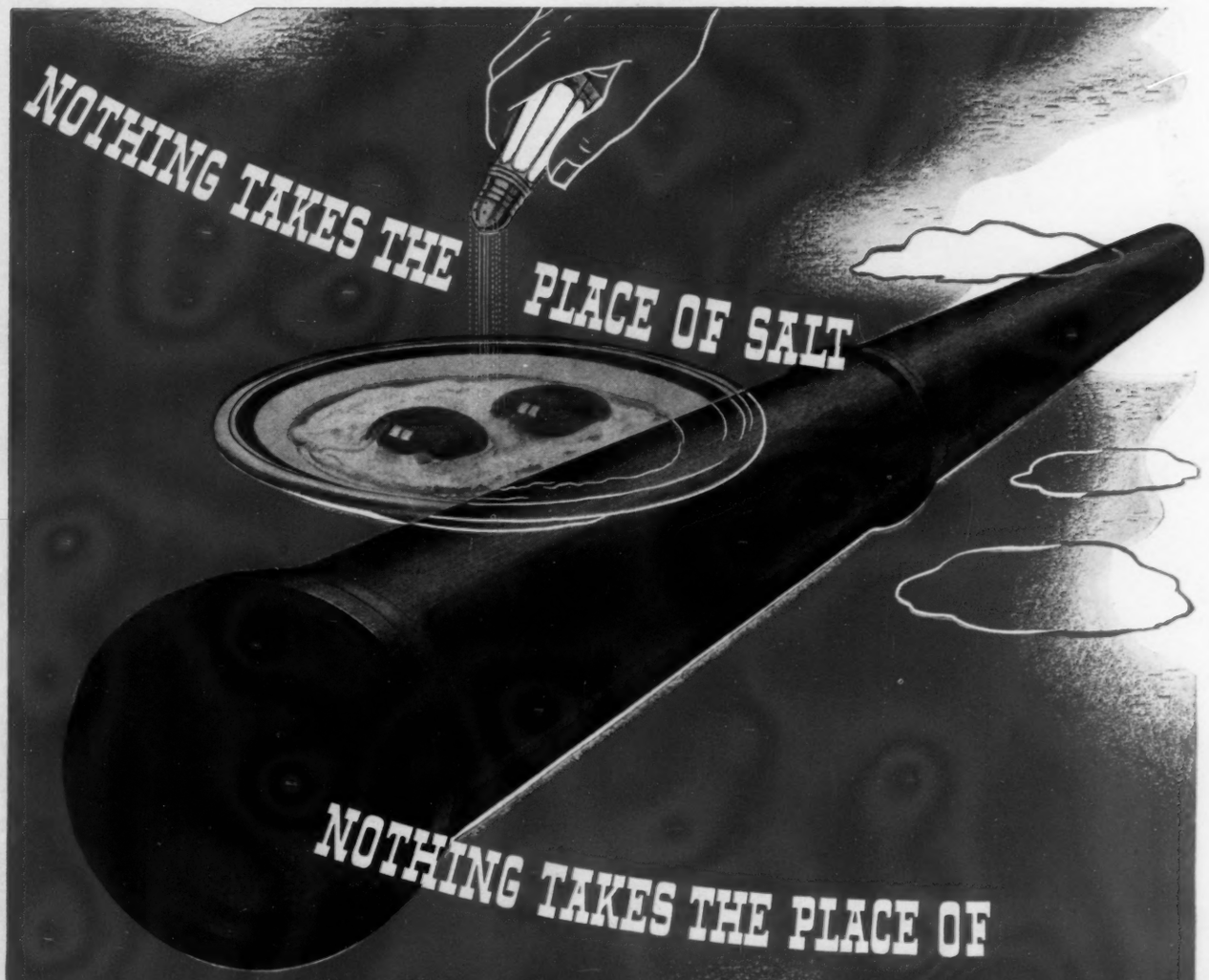
MAY 14-21 1938

Exhibits and demonstrations at the International Petroleum Exposition will include every division of the oil industry. Not the least of these will be the pipe line department. The latest methods, equipment and materials used in construction and operation of pipe lines for the transportation of crude oil and refined products will be shown—line pipe, valves and control equipment, pumps, engines and booster plant equipment, safety and communication devices.

It will be the greatest exposition in the fifteen years history of the world's first, oldest and largest oil show. Write for full particulars.

WM. B. WAY, General Manager, Tulsa, Oklahoma, U.S.A.

INTERNATIONAL PETROLEUM EXPOSITION



CAST IRON PIPE

SALT for your table—cast iron pipe for your underground mains—nothing takes their place. Both are basic and indispensable as they have been for centuries. Both are better products today than they were 20 years ago.

If you demand *proved* long life and low maintenance cost that result from effective resistance to corrosion — assured safety margins for impact, beam load and crushing stresses—with permanently tight joints—then you will agree that *nothing takes the place of cast iron pipe.* Some materials meet some of these requirements but only cast iron pipe meets them all.

CAST Q IRON

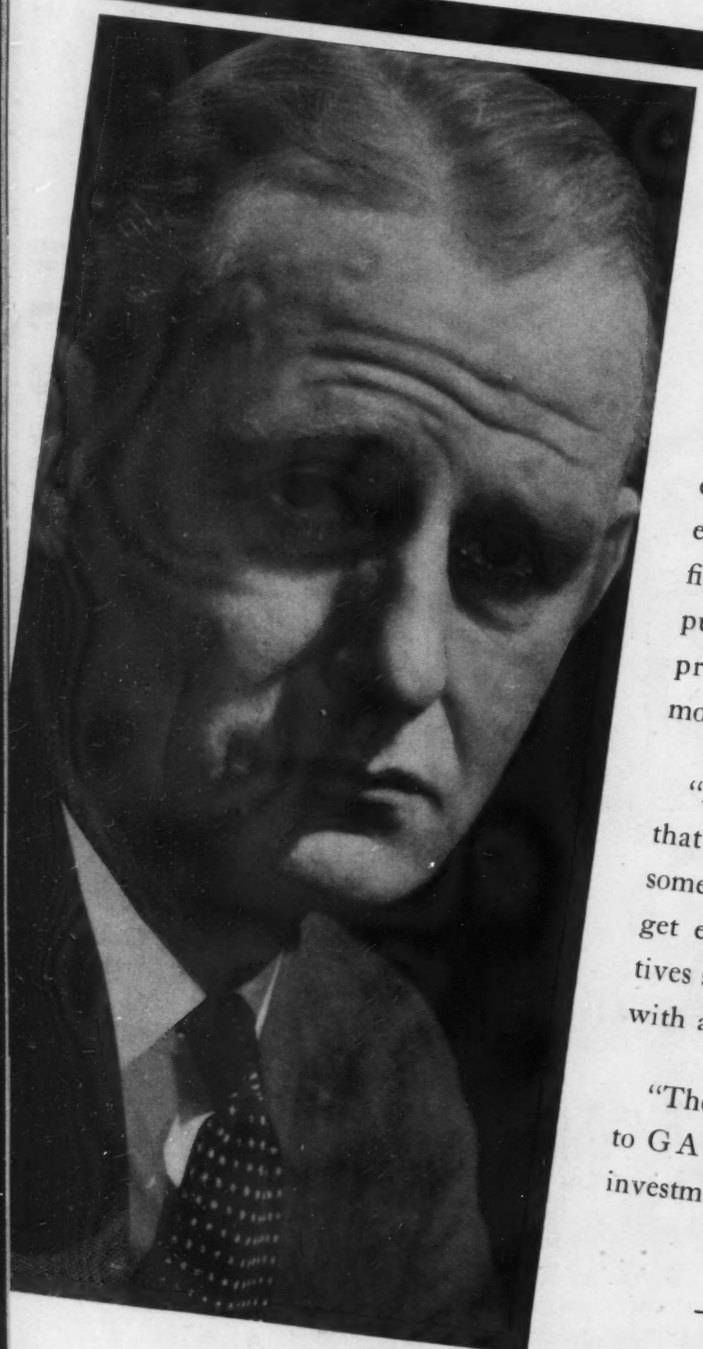
Look for the "Q-Check" registered trade mark.
Cast iron pipe is made in diameters from 1¼ to 84 inches.

THE STANDARD MATERIAL FOR UNDERGROUND MAINS

Installing mechanical cast joint iron pipe for high pressure gas service. The joints are bottle-tight. The material, long-lived and economical.

THE CAST IRON PIPE RESEARCH ASSOCIATION, THOMAS F. WOLFE, RESEARCH ENGINEER, 1013 PEOPLES GAS BUILDING, CHICAGO, ILLINOIS

"Sure, I'm a SAD GUY ... sometimes!"

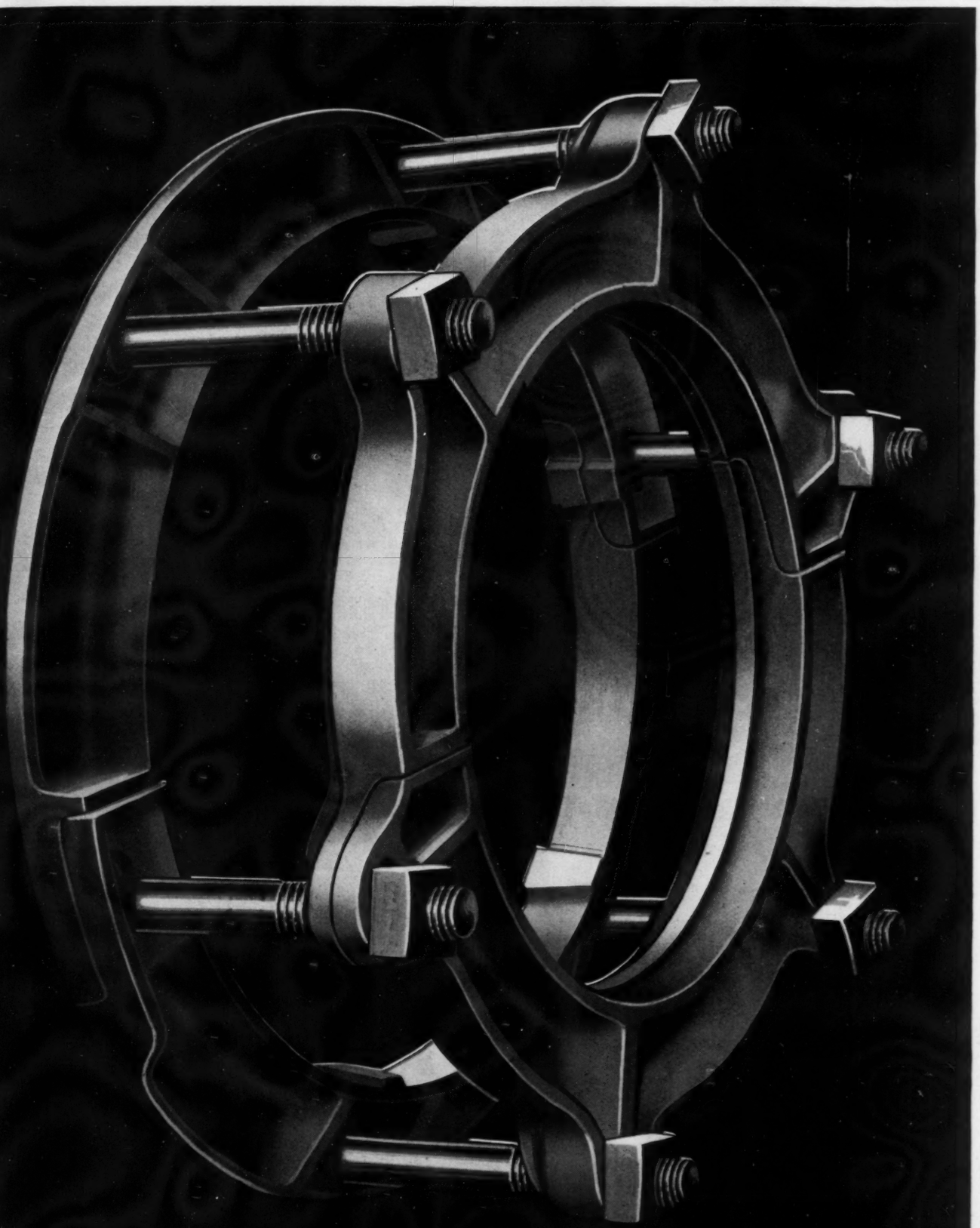


"Many salesmen have bumped into my stock lament that 'business is bad'. Well, sometimes business *is* punk, but usually my grief is just a protective mask that I have adopted to discourage salesmen. After all, I'm a busy man! But when I pick up my copy of G A S, I am plenty alert. Those editors are specialists in the natural gas field. They gather useful ideas which, when put to work, create better business and more profit for me. The worse business is, the more I need their help!

"And I read the ads, too, for I know that they are in G A S because they have something real to offer . . . not because they get editorial publicity. Their representatives stand the best chance of being greeted with a smile in my office!

"The money I pay for my subscription to G A S is not an expense . . . it's the best investment I make each year!"

DAYTON 12-B CLAMPS

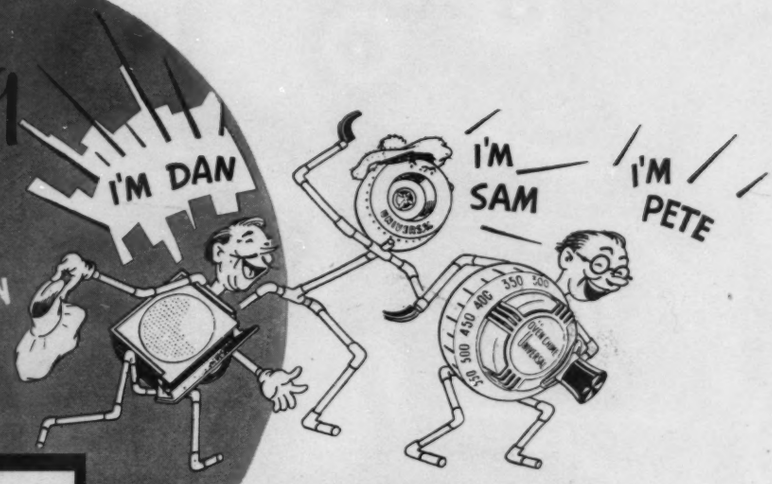


EFFECT A PERMANENT REPAIR
IN BELL AND SPIGOT PIPE JOINTS

THE NATIONAL SUPPLY COMPANY
(DAYTON COUPLING DIVISION)
TOLEDO OHIO U.S.A.

Introducing

SIMMER-SAVE SAM
PRECISION PETE
IN-A-DRAWER DAN



Introductory broadside, introducing the 1938 Universal Review and the Six Point Sales Program.

Act 1 features Greater Cleanliness, emphasizing the fact that there is less work for the Homemaker with a modern gas range.

This broadside covers Act 2 of the 1938 Universal Review. It emphasizes Greater Comfort for the Homemaker.

Act 3 covers Greater Convenience and stresses the fact that if the range is not modern, it cannot be convenient.

Act 4 deals with Better Results for the Homemaker, and features a cooking service free from guesswork and failure.

Act 5 stresses the point that the Greater Adaptability of gas makes for a more flexible cooking service.

The final act emphasizes Greater Economy—showing wherein the modern gas range actually is a source of Greater Economy to the Homemaker.

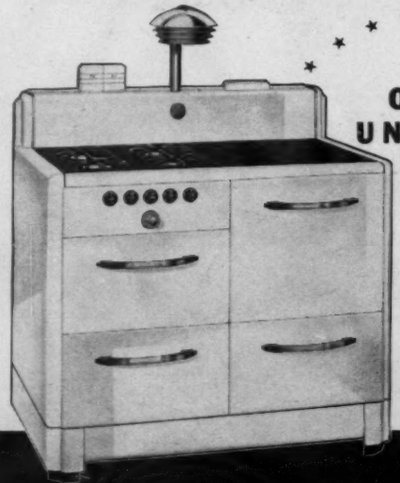
The Three Musketeers OF THE GAS RANGE INDUSTRY . . .

★ On the Gas Company's salesman's knowledge and appreciation of the inherent advantages of gas as a cooking fuel, and particularly on his enthusiastic presentation of the story of the modern gas range to the consumer, to a great extent, rests the case of gas as a cooking fuel.

As an aid to the salesman and for use as a guide in presenting the true story of the modern gas range Cribben and Sexton Company has developed the Six Point Sales Program.

To dramatize this program and to more thoroughly acquaint the salesman with the sales plan, a series of seven broadsides have been created. These broadsides feature the three Universal characters, Simmer-Save Sam, Precision Pete and In-A-Drawer Dan as the principal actors in the Six-Act Universal Review. These broadsides are designed for mailing direct to gas company salesmen.

For complete information relative to the Universal Six Point Sales Program, write Cribben and Sexton Company, 700 N. Sacramento Boulevard, Chicago, Illinois



OXFORD UNIVERSAL

Universal advanced devices read like a roll-call of every worthwhile modern gas range improvement. The Universal features "flush to the wall" construction.

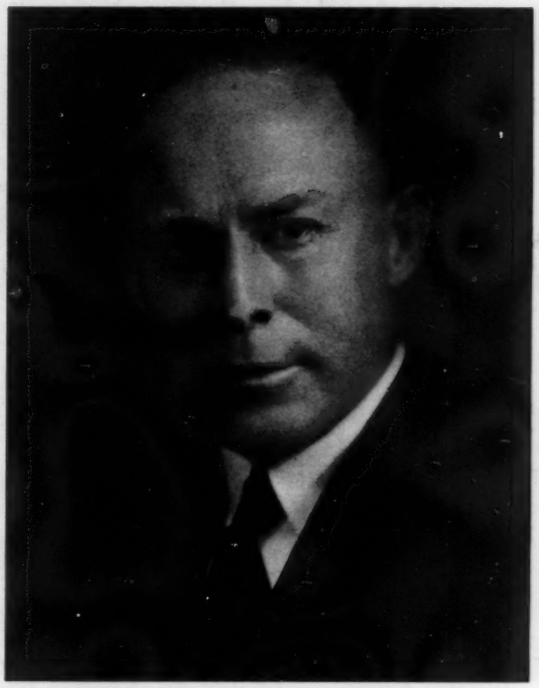
UNIVERSAL GAS RANGES

MANUFACTURED BY

CRIBBEN & SEXTON COMPANY, 700 N. SACRAMENTO BLVD., CHICAGO, ILL.

GAS
April, 1938

Guest Editorial



An Optimistic Prediction

By R. E. FISHER

Vice-president in charge of Public Relations and Sales
Pacific Gas and Electric Company

IT always takes considerably more effort to discuss a subject when in the depths of a recession; we are not only afraid to be optimistic because of possible later criticism, but we are also hesitant to be pessimistic because of the possibility of stifling what little enthusiasm is still tenaciously clung to by some few of us. However, on this particular occasion, I am not one bit hesitant about making an optimistic prediction for the future of 1938 for the gas business.

Here in California we are especially well situated due to the diversity of our products. Our major industries are agriculture, oil, mining, aviation, moving pictures, general manufacturing and last but not least our tourist trade. The relationship of these major industries is such that each lends a balancing effect to the other in the case of retardation of business in any one of the respective lines.

Now, with regard to gas:—its public acceptance for cooking, water heating and heating is unquestioned in California, and there is considerable progress being made in the field of gas refrigeration. We have plenty of healthful competition, but our real problems come from national forces over which we have little or no control. By that, I mean we are continually being required to absorb increased taxes and higher wage levels in the face of public demand for lower rates for our commodity. These basic increases in the costs coupled with the psychological effect of the recession call for a job, on our part, of more selective selling, thus insuring more profitable loads for our lines.

Industries of all types like our own face the problem of producing more efficiently to offset these rising costs. How this is to be done is a problem for each individual industry to work out. About 10 years ago, I heard a very prominent economist say that in order to produce more efficiently, it would be necessary for industry to reduce the labor content of the products they produce. In this connection, I regret to say that in the face of the present labor unrest, that is exactly what most concerns are concentrating on. In other words, when anything interferes with the reasonably free marketing of one's product, he naturally concentrates on some method of eliminating or retarding that resistance. The present slump in needed home construction, I believe, is the result of too much labor content. Look at it any way you wish and you will find that home construction is flirting with mass production principles due to increased labor and material costs. The Federally-promoted home building program designed to stimulate home construction will get along only if labor will make an attempt to assist in this program by a more stable attitude even to the point of making concessions. I believe these adverse problems have much effect on general progress in all lines.

If labor will cooperate in getting house construction started, I feel confident that once the ball is rolling, a much better general situation will exist for labor as a whole.

I might say that we in California, at the present time, are very fortunate for many reasons.

First, we have the Golden Gate International Exposition coming up in 1939 which will stimulate business in all lines.

Second, the diversity of industries in the State assures us a balanced condition at all times.

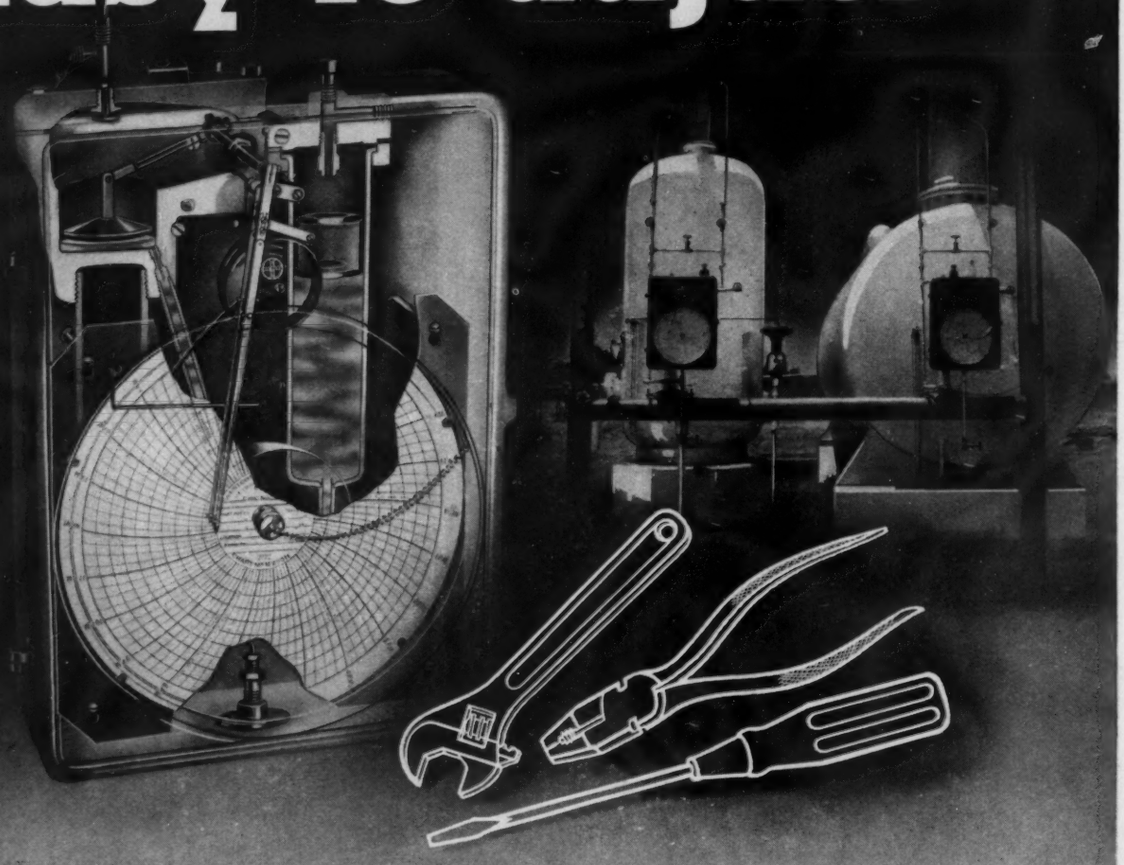
Third, it is a fact that there is a definite trend of industrial movement Westward endeavoring to take advantage of our growing possibilities and undeveloped natural resources. We are entering an era of industrialization.

Naturally, these constructive conditions make me optimistic about California and the West; therefore, I think the sales programs of gas utilities should be most aggressive these next two years to take advantage of these favorable conditions.

I realize that there is going to be plenty of competition for the customer's dollar, but most of the utilities have well-trained competent sales organizations backed by appreciative managements who realize the essential function of sales for the continued growth of the gas business.

It is hazardous to presume to forecast what 1938 will bring, but it is my opinion that by the end of 1938, once we get going, we will offset to a very large degree the slump experienced in the last three or four months. To accomplish this, however, I feel that we must set aside from our minds the national problems and devote our every effort to aggressive local sales promotion.

Easy to adjust



out in the field

LET'S SEE HOW EASY it is to adjust a Westcott Orifice Meter! The door of the dust-and-moisture-proof aluminum case merely is swung open . . . exposing pressure spring, clock, chart, and recording mechanism. Or, by speedily removing the low-pressure chamber cover of the forged-steel differential gage body, the entire interior is accessible . . . without loosening a single connection that affects accuracy. Adjustments do not interfere with any of the working parts . . . few in number and simple in design, despite their many features and refinements.

Comprehensive literature describes the expense-saving Westcott Orifice Meters and Flowmeters . . . clearly defines their applications. Specifications on the popular new Round Case Indicating Flowmeters also will be mailed on request.

AMERICAN METER CO. MEASUREMENT ENGINEERS CENTENNIAL 1836-1936

343

AMERICAN METER COMPANY
INCORPORATED
Measurement and control of Gas, Oil, Steam, Air and Liquids
PACIFIC METER WORKS • LOS ANGELES • SAN FRANCISCO

GAS
FOURTEENTH YEAR OF PUBLICATION

Thermally Thinking

By Stanley Jenks

Editor

The Lesson Of T.V.A.

Dogberry, in Shakespeare's "Much Ado About Nothing" says "Comparisons are odorous." (Yes, he really says "odorous.") And the comparisons we can make between what was promised and what has happened in T. V. A. certainly smell to high Heaven, as revealed by the allegations, charges and countercharges of the three T.V.A. directors and their political backers. Chairman Arthur E. Morgan has recently declared, "The real difficulty has been in the effort to secure honesty, openness, decency and fairness in government."

The President, who appointed the three directors, and who is therefore directly responsible for their actions, was forced to call a meeting of the triumvirate at the White House and 79 sheets of typewritten transcript of the meeting were issued, without a decision being made, before adjourning for a week prior to final action.

"Go South! There you will see best what we have done and what we are trying to do," said President Roosevelt two years ago as he proudly recommended T.V.A. to a visitor. Time is revealing the truth, as it usually does. The electrical rabbits that were to be pulled out of the magical hat are turning out to be political polecats.

The Tennessee Valley Authority Act was passed March 18, 1933. Among its objectives, such as flood control and better navigation for the Tennessee River, soil and natural resources conservation, it provided for the generation and distribution of electric energy from the dams created in this program. A most ambitious project, but such is political management, that when the dust had cleared away, it was found that two college presidents and a political lawyer were running the show.

The Chairman of the triumvirate was Dr. Arthur E. Morgan, formerly president of Antioch College and an engineer with some experience in land reclamation and flood control. He took charge of construction.

Dr. Harcourt A. Morgan was president of the University of Tennessee, and an eminent horticulturist and entomologist. He headed the fertilizer branch.

The third member, David E. Lilienthal was at one time a member of the Wisconsin Public Service Commission. He is a lawyer. He became the electric expert and chief power salesman.

Such is the trio who have so far spent $170,000,000 of the taxpayers' money, and for which it seems impossible to get an accurate accounting, as they ran charging around like bulls in a china shop. The chairman is opposed by the other two. As we write, he seems to be fighting a losing battle, for Messrs. Harcourt A. Morgan and Lilienthal have the political blessings of your Norrises, La Follettes and suchlike, the group in Congress that the President is so anxiously cultivating in the furtherance of his radical ideology.

The lesson of T.V.A. will be cheap, even though it has cost $170,000,000 to date, if we will learn it. It is an outstanding example of the vicious ineptitude of political management. As an effort in the public utility field, to better the job already being done economically and adequately by the privately managed power companies.

We gas men have a decided stake in what is happening with T.V.A. The issue is whether our public utilities shall be publicly-owned but privately-managed as they are today, or whether they shall become another trough at which their political managers can feed their henchmen at public expense.

The Smoke Evil

I am sure that there will be one most enthusiastic individiual in the gas industry, who will be interested in a proposal that was recently advocated at a meeting of the Smoke Abatement Society in London, England. I have in mind Henry Obermeyer, the advertising mogul of the Consolidated Edison Co., New York, whose book "Stop That Smoke!" (Harper & Brothers) is stili the outstanding authoritative textbook for laymen

available. Every gas man should have a copy, especially salesmen, for it is a real sales story in itself.

Back to the British situation, the delegates were quite startled to learn that sootfall on London amounts to 75,000 tons a year, and as high as 400 tons on a given square mile. The domestic coal fire was blamed as the main offender.

There were two suggestions made. The first was that local municipal bodies should obtain the necessary authority to make a rebate of 6 cents per $5.00 assessment to householders whose heating equipment was smokeless. The second was that "smokeless zones" be defined and established. In such areas "The emission of smoke from any house, business premise, or factory should be forbidden after a certain interval, and the resources of the state, the local authorities, and the fuel industries should be combined to enable alternative measures to be taken with no individual hardship."

Of course, you can pipe up and say, that this is in England. But, as one who has tramped the streets of most of our own leading cities, I can testify, that American coal is just as good an atmospheric polluter as any that Tommy Farr ever dug up in his native Wales. Then there's the immortal classic:

> Mary had a little lamb,
> Its fleece as white as snow,
> She took it down to Pittsburgh—
> Now look at the damned thing.

Seriously though, we gas men are battling other fuels for supremacy. Henry Obermeyer in his book shows what solid fuels are costing us in actual dollars and cents in terms of doctors' bills for infected throats and lungs; laundry bills for soiled linen; and house maintenance in time, effort and money to clean off the sooty film which solid fuels scatter promiscuously into everybody's air.

Home Service

She, who scrapes the gears on the family chariot, joined a cooking school sponsored by our local gas company three months ago. The series of lessons or lectures, given under the auspices of the Ladies' Aid of a nearby church, were concluded recently. I have been quite interested in her reaction.

There was nothing unique about the classes. As many gas companies do, the company provided the gas range, gadgets, utensils and ingredients. The good ladies of the church sold tickets six for a dollar, kept the proceeds and extended the facilities of their clubrooms. The admittance tickets were numbered, and the women attending the lectures raffled off the dishes prepared at every session. Her ladyship was lucky, for one day she came home with a maple and pecan nut pie, and another time with a jar of marmalade.

But, I'm ahead of my story. She was simply amazed at the non-commercial atmosphere. No attempt to "plug" any particular make of gas range. You weren't even asked to buy a thing, she said. But she came home, all imbued with the marvelous things like timeclocks on ovens, that were incorporated in the modern gas range. Had we been anything else but "Cliff-dwellers" as John Weedon used to dub us people who live in apartments, I know I would have had a very dissatisfied wife on my hands, until our present range went on the junk-pile. (Come to think of it, that's probably why she is always taking me to look at houses.) "It cannot possibly pay them," she declared, never for one minute considering the extra hours she has spent in her kitchen since she joined the class, trying recipes and tricks that were handed out, and confections that she would never have dreamed of trying before.

Then there are her friends, to whom she has passed along successful recipes, and who, stimulated by her success, will have a shot at them themselves.

"How does it pay?" she has asked. May she never find out, for it would spoil her fun. Anyway, it's a grand way to sell more gas to existing customers.

Load Values

The thing that impresses me tremendously is the wide difference in the estimates you get, on the load values of our regular domestic appliances. And more startling still, how few gas men have actually little more than a theoretical knowledge of what is really a most practical matter. Too often, we are inclined to take ratings of burners, the thermal and overall efficiencies, and take a stab at the probable cost. Yet, particularly in designing and applying promotional rates, could anything be more essential than actually knowing what revenues can be anticipated from this or that appliance?

To start the ball rolling, here are the annual added load values set up by a company I know.

Appliance	*Load Credit*
Gas range (Replacement)	38 therms.
Gas range (New customer)	114 therms.
Automatic water heater	137 therms.
Home-Heating job	estimated
Auxiliary space heater	12 therms.
Gas refrigerator	120 therms.
Incinerator	10 therms.

What do you think?

In a Nutshell

It was never more aptly put, than the way Keynoter Walter C. Beckjord at the Mid-West Regional Gas Sales Conference, laid it on the line, when towards the conclusion of his address he said:

> "This shows it is possible to meet competition, and the old idea that we could still earn a return on investment made year after year without the necessity of meeting the competitive situation, is gone with the wind."

It is all there, the story of what our rate experts must figure from, if our industry is to progress as most of us think it can and will progress, once it faces competitive fuel facts.

Rain Fell on Southern California

Natural Gas Service Meets Crucial Tests During Severest Storm in Sixty-one Years

ON Monday February 28, 1938, no less an authority than Dr. Irving Krick, meteorologist at California Institute of Technology, warned of the approach on Southern California of a bigger storm than had hitherto been experienced this season. Few, save those whose memories went back to 1913, had any idea of the impending storm's possible magnitude. Fresh still in everyone's mind was that disastrous downpour and flood of New Year's Eve, 1933, when great damage was done above Glendale in Los Angeles County. Considered an all-time high for weather as far as Southern California is concerned, the 1933 flood was the generally accepted idea of the worst that could happen.

Certain facts might have caused apprehension had everyone really stopped to consider them. These had to do with rainfall, which up to the first of the year had been far below normal. Indeed, the dry spell preceding the first rain of the season in November, had been one of the longest on record; and up to January 1, 1938, only slightly over two inches of rain had fallen.

The real rainy season, usually well advanced by the middle of November, began belatedly in January; and during the month over five inches of rain had come to saturate the parched watersheds. February saw an intensification of weather disturbance, storm after storm coming to lash the coast all the way from San Diego north to Alaska. During the month nearly 10 inches of rainfall was recorded by the U. S. Weather Bureau station in Los Angeles, rainfall in surrounding territory was even heavier.

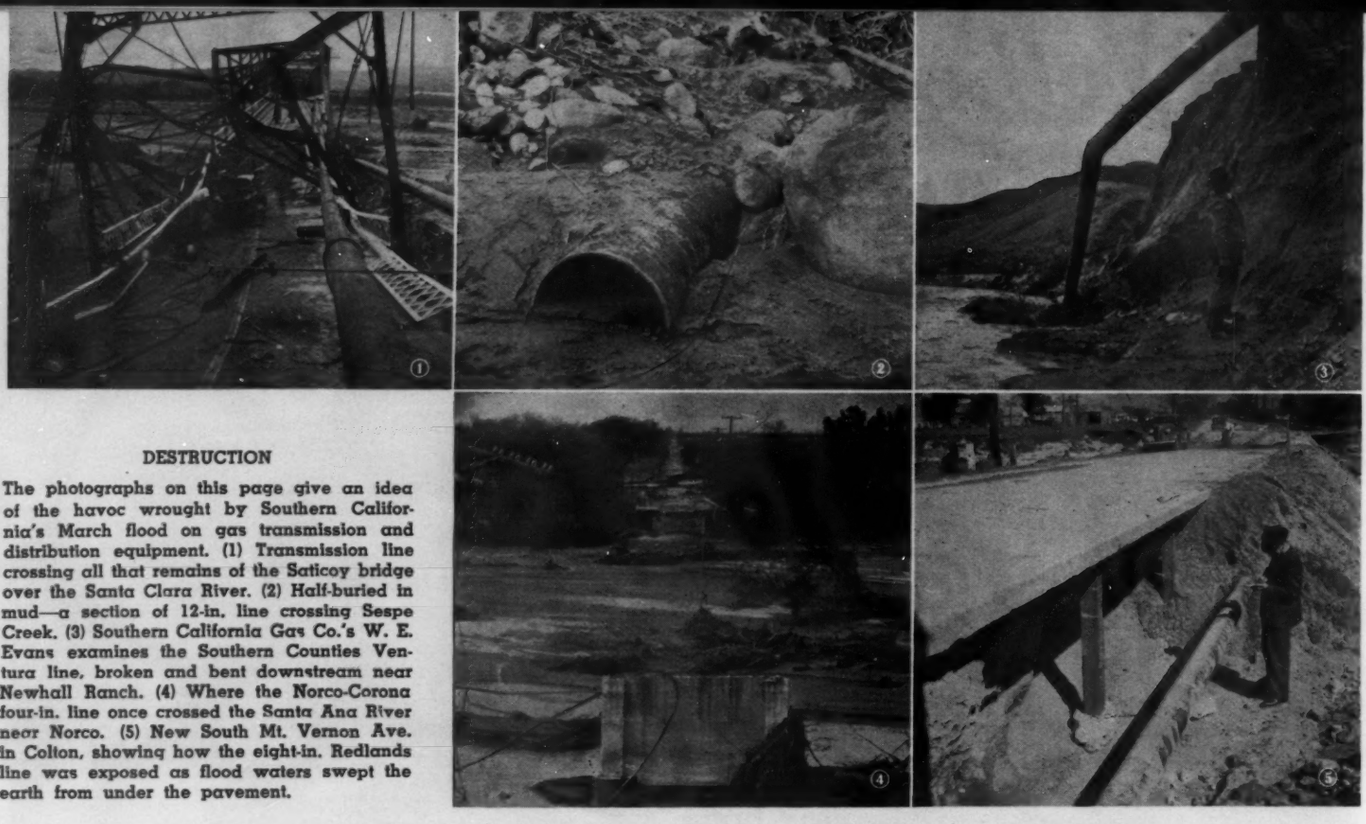
THIS STORY of the struggle between the gas companies and the recent drastic flood conditions which existed in Southern California has been made possible only through the helpful cooperation of many executives of the Southern California Gas Co.; the Southern Counties Gas Co.; and the Industrial Fuel Supply Co. G A S wishes to express its gratitude for the cooperation rendered by these gas company officials who took time out during a period of stress in order to aid in the production of this article—Editor.

The season's total at the time Dr. Krick made his ominous prediction was 17.26 in., most of which had fallen within a quite limited period. Already the watersheds had absorbed as much as they could hold for the time being, and the promise of more rain did not look so good. The leonine shadow of that March storm on the Pacific, then, fell across a rain soaked Southern California landscape. In the last three days of February, alone, four and a half inches had fallen.

The big rain started at about nine o'clock on Tuesday evening, March 1, and continued throughout the night, increasing in intensity as morning approached. By eight o'clock on the morning of March 2 the whole coast from San Luis Obispo south to San Diego was a fury of rain with some wind. Used to sudden downpours and equally abrupt let-ups, people all over the Southland left their homes for work, confident that the deluge would be over in an hour at the utmost. But the rain continued.

All Wednesday morning it rained, never ceasing. Streams and storm-drains were filled and could hold no more. Downspouts became geysers, gutters became rivers, and streets became torrents. In Los Angeles, transportation staggered under the impact of rain and swirling water—slowed—came to a halt. Everywhere people were marooned, cars stalled, street cars stopped, — walking was almost impossible. Unable to go forward to their offices or back to their homes, groups huddled under awnings, in doorways, wet and apprehensive.

By noon there was scarcely anyone who was not aware that a storm of major proportions was in progress. By mid-afternoon, with the rain continuing unabated, everyone knew that Southern California would be fortunate indeed to escape without extensive damage and, possibly, loss of life. Newspapers whirled off presses with a medley of reports from all over the Southland telling of rising rivers,



DESTRUCTION

The photographs on this page give an idea of the havoc wrought by Southern California's March flood on gas transmission and distribution equipment. (1) Transmission line crossing all that remains of the Saticoy bridge over the Santa Clara River. (2) Half-buried in mud—a section of 12-in. line crossing Sespe Creek. (3) Southern California Gas Co.'s W. E. Evans examines the Southern Counties Ventura line, broken and bent downstream near Newhall Ranch. (4) Where the Norco-Corona four-in. line once crossed the Santa Ana River near Norco. (5) New South Mt. Vernon Ave. in Colton, showing how the eight-in. Redlands line was exposed as flood waters swept the earth from under the pavement.

flooded streets, and threatened homes. And still the rain continued.

It continued throughout Wednesday night, and diminished only as dawn broke on Thursday. And with the coming of that dawn, came realization that Southern California had been struck a hefty blow indeed. During the night death and destruction had been rampant. Telephonic communication anywhere save between local points had ceased. No one community knew what had happened in the community across the river or over the hills. Bridges were down, roads were out. Trains, caught between streams that had become rivers overnight, could not move. No one knew the extent of the damage.

During 36 hours 6.66 in. of rain had fallen in Los Angeles proper; 17 in. had fallen on the Pacoima and Big Tujunga watersheds; 21.5 in. on the San Gabriel and San Antonio watersheds; and 28 in. on the watersheds along the San Bernardino mountains. Statistics, gathered afterward, indicate that the bulk of water fell on the mountains, causing a rapid run-off and enormous inflow into the rivers draining toward the sea. The brunt of the storm was borne in the immediate vicinity of Los Angeles, reaching a maximum apparently, as indicated by the rainfall figures, in the San Bernardino watershed and areas adjacent.

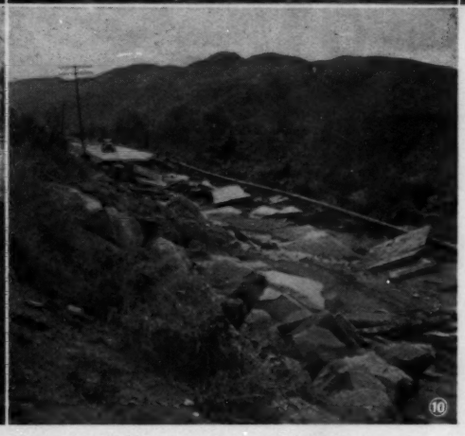
Drained mainly by the Santa Ana river, this watershed sent an almost unprecedented volume of water down to the sea, tearing out bridges, gutting roadways, flooding farms and destroying houses. In Riverside, a park and a large residential area were flooded. In Anaheim, farther down the river, half the town lay under feet of water. And where this erratic waterway debouches into the sea, a lake formed where a lake had never been before,—five miles wide and eight feet deep, spilling into the Pacific across the wreckage of the coast highway.

San Bernardino, Riverside and Orange counties were perhaps hardest hit. But Los Angeles and Ventura Counties suffered along with them. The Los Angeles river, filled from the San Gabriel watersheds and watersheds at Big Tujunga and Pacoima, ripped at its banks, tore out bridges and ran generally amuck. The Santa Clara river, scene of the great St. Francis dam disaster in 1928, once again reared up and tore toward the sea, swelled by tributaries pouring into it from a hundred miles inland.

Warned by Dr. Krick, who this winter had begun a special weather service for the industry, local gas companies had set themselves to take the shock of this storm. Unable to foresee all that was in store for them, they were nevertheless on the alert. Watchmen and patrolmen were sent out along gas lines and stationed at bridge crossings to check the rising water. All was reasonably normal during the first night of storm, and everything remained under control well into Wednesday morning. Then things began to happen.

The natural gas system of Southern California is dependent to a considerable extent on the fields in southwestern San Joaquin Valley, and in the Santa Barbara-Ventura area. Of the more than 300,000,000 cu. ft. normal winter daily demand, approximately 60 per cent comes from these

AT LEFT: Terrace Road, San Bernardino, showing a twisted and broken four-in. crossing. ABOVE: A boulder lodged in a broken piece of the 12-in. Southern Counties line at the Big Tujunga river crossing.



RECONSTRUCTION

The gas companies went to work immediately repairing broken lines and restoring service. (6) Constructing new trestles for 8-, 12-, and 16-in. lines over the Santa Clara River. (7) Men at work on the wooden frame used to support two suspension cables for stringing line across the Santa Clara. (8) Temporary four- and six-in. lines crossing Warm. Creek at Waterman Avenue in San Bernardno. (9) Man power was concentrated in San Bernardino in efforts to repair distribution outages. At work in the ditch. (10) At Newhall Ranch, showing highway washed out. Pipe salvaged from the 12-in. Southern California Gas Co. line was used as a by-pass for the 12-in Southern Counties Gas Co. line.

points. The balance is supplied by the Los Angeles basin fields. Not lengthy compared with mid-continent pipe lines, the transmission mains cross a rugged terrain and a number of streams. One of the largest of these is the Santa Clara River, which has its source in the mountains at the edge of the Mojave Desert and travels a hundred miles to the sea picking up water from a number of tributaries all along the way.

It was on this river that the first trouble on the transmission system began. Every pipe line coming from San Joaquin Valley and the Ventura-Santa Barbara basins must cross it at least once and in some cases twice or more. At 1:30 P.M. on March 2, word came into despatching headquarters in Los Angeles that the 12-in. lines of the Southern California Gas Co. and the Southern Counties Gas Co., both crossing the river at Sespe, had gone out with the collapse of the east approach of the highway bridge. (See map on page 20, II and III).

The rapidity with which things happened from then on is caught graphically in the following excerpts from the log of Roy M. Bauer's office where operation of natural gas supply facilities for all of Southern California is coordinated:

1:30 P.M. Southern California and Southern Counties' 12-in. lines reported broken at Sespe river crossing —420 ft. of east bridge approach washed out. (Map, II, III).

1:40 P.M. First four blocks of industries and large transport consumers ordered switched to oil fuel.

2:40 P.M. Eight-in. San Bernardino-Colton line reported out at Lyttle Creek. Started heating Colton Station generators. (Map, XXVI).

2:59 P.M. Eight-in. bypass in Rio Hondo river at Anaheim-Telegraph Road found broken. (Map, XIV).

3:15 P.M. Placentia plant (Industrial Fuel Supply Co.) report discharge pressure has been dropping rapidly since 2:45 P.M.

3:38 P.M. Ordered Colton to make gas.

3:50 P.M. Los Angeles River crossing at 9th Street (Spence Station—Central 16-in. connection to Southern Fuel 26-in.) washed out. Caught fire but shut down by 4:15 P.M. (Map, XII).

4:07 P.M. Edison's Long Beach station curtailed to minimum gas load.

4:25 P.M. Lee Holtz, general superintendent of distribution, Southern California Gas Co., orders all valves on all bridges across Rio Hondo and Los Angeles rivers closed.

4:55 P.M. Southern Counties 10-in. Carbon Canyon line broken near Orange-Riverside counties line. (Map, XIX).

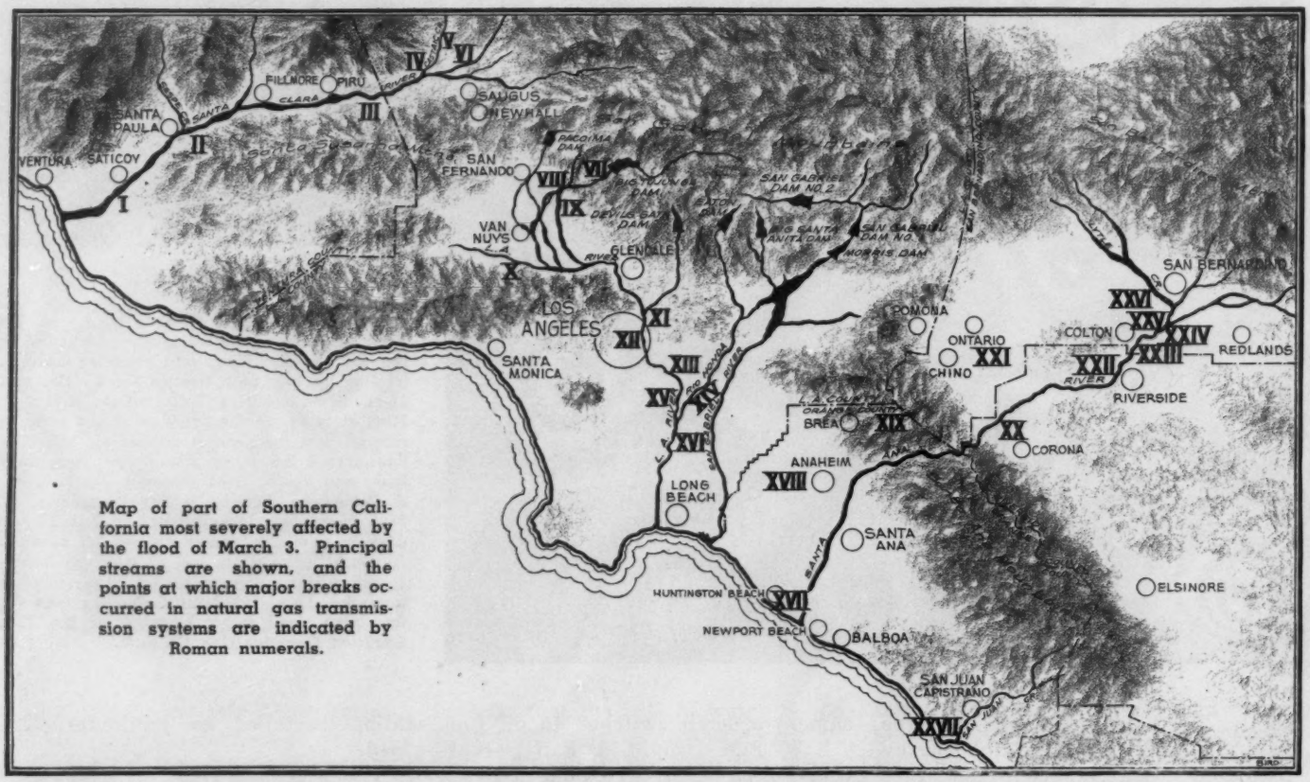
4:55 P.M. Saticoy bridge washed out, three spans gone. Industrial Fuel Supply Co., 15-in. line suspended on bridge torn away, 2550 ft. lost. (Map, I). Ordered additional industries curtailed.

5:25 P.M. Southern Counties 12-in. line across Big Tujunga wash, west of San Fernando Road, torn out, 1500 ft. lost. (Map, IX).

6:15 P.M. Southern Counties 12-in. line to San Diego shut down at San Juan creek (fell and broke one and one half hours later). (Map, XXVII).

6:30 P.M. Southern California 16-

ABOVE: An undercut 26-in. line near the Santa Clara River. Pipe was found floating on water. AT RIGHT: At Newhall Ranch, a temporary tie-over from the 12-in. Southern Counties to the 12-in. Southern California line.



Map of part of Southern California most severely affected by the flood of March 3. Principal streams are shown, and the points at which major breaks occurred in natural gas transmission systems are indicated by Roman numerals.

in. line on Remsen Avenue broken across Big Tujunga wash. (Map, VII).

Not mentioned in the log is the fact that by 6 P.M. Wednesday all telephonic communication with outlying stations, except Ventura, had ceased. Contact by telephone with Ventura was not lost until the following morning when the famous row of eucalyptus trees along the highway at Camarillo began to crash across the toll line. The log notes that a short wave message was sent to Newhall via the Sheriff's radio, and later Taft was reached by long distance through San Francisco.

The part that short wave amateur radio played in maintaining contacts is interesting. C. S. Pool, purchasing agent for the Industrial Fuel Supply Co. and a well known figure in amateur radio circles, turned his private station over to the gas companies. Working most of the night, he established contact with a station in Redlands, one in Taft, a third in Santa Barbara, and a fourth in Fillmore. Reports from field stations were received at headquarters by this means and messages giving directions for operating procedure were transmitted back to the field.

A little after 8 o'clock on Saturday night Dave Gamble, transmission foreman at Southern California Gas Co.'s Newhall station, decided to have one more look at the situation before standing by for the night. All afternoon he had been watching the Santa Clara River rising at Castaic Junction, where the three big transmission lines from San Joaquin Valley cross. He decided he would have another look there.

Taking an assistant with him, he drove as close to the river as he could get in his car and, leaving the headlights on, walked on down to the river bank. The two men stood there for a few minutes trying by means of flashlights to see what was going on down below, but all they could discern was a torrent of swiftly moving water.

They turned back finally, but had scarcely taken a dozen steps before the whole sky lit up behind them and a deep roar rumbled up from the river bottom. They didn't wait to investigate, knowing that the Southern Fuel 26-in. line (Map, VI) carrying about 200 lbs. pressure, had been pulled apart by the terrific force of the flood waters. Racing toward their car, they rushed to the control valve box which, stood directly in the full glare of their car headlights and shut the line down.

At the same moment, across the river, Southern California Gas Co. patrolman Sutton heard the explosion and the telephone advised the pressure on the Southern Fuel 26-in. line was dropping rapidly. Without an instant's hesitation he and D. Frew raced for the valve control box, which he found full of water. Taking a deep breath he plunged in and gave the valve wheel as many turns as he could before he had to come up for air. It took a number of breaths and a number of turns to get the valve closed off.

Prompt action of these men saved the gas remaining in the line, and when a cross-over was established at Atmore and also at Castaic Junction, coupling the 26-in. with Southern California's 22-in. and 12-in. transmission lines, a large portion of main remained in service.

The first trouble in the distribution system was experienced in Los Angeles when, at about 11:00 o'clock on the morning of March 2, the Avenue 43 bridge across the Arroyo Seco was undermined, carrying away the gas main crossing at this point. Some 600 customers were affected.

Two hours and a half later word came into Southern Counties Gas Co. headquarters that consumers in Fillmore and Piru were out of gas. Supplied from the 12-in. transmission line (Map, II and III) from Ventura to Los Angeles, they had been cut out when this line carried away both above and below the two towns where the line crossed the Santa Clara River.

Telephone communication between Southern California Gas Company's

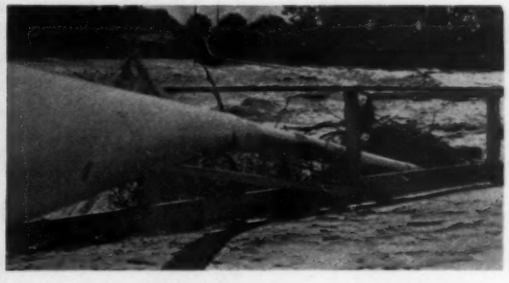
(Continued on Page 82)

GAS CAMERA

Random Shots of Gas Industry Activity During Southern California's March Flood

DANIEL WHIPPLE, assistant chief gas maker for Southern California Gas Co. was called to the Diesel oil plant as flood conditions cut off the Los Angeles supply. BELOW: A temporary line was constructed over the Foster Road Bridge, which crosses the Rio Hondo.

DEVASTATED AREA, pictured below, is seen toward the West across Owl Creek bridge near Banning, Calif., on the Ocean to Ocean highway. Broken four-in. gas main lies in the foreground.



AT RIGHT: Work progresses on suspension cables used to support a temporary 10-in. line crossing the Santa Clara where two spans of the Saticoy bridge were washed out.

BELOW: Some 600 feet of Industrial Fuel Supply Co.'s 15-in. Ventura line was lost as the Saticoy bridge yielded to the flood. A welded joint held as the pipe proper was twisted and broken.

JOSEPH E. HUGHES, 20-year-old Industrial Fuel Supply compressor plant oiler, three times carried a rope across the turbulent Santa Clara before making successful contact. G. W. Thurmond, Saticoy rancher, pulls him out. BELOW: A house tumbles into Lytle Creek in the Southern Pacific yards at Colton.

A partial view of the Grand Rapids Co. sales floor, as it appeared during the Round-Up campaign, decorated with balloons and paper pennants. Employees are shown wearing the scarfs and ten-gallon hats presented to them at the opening of the drive.

Grand Rapids Gas Light Co. Rounds Up Old Ranges

● **WALLACE M. CHAMBERLAIN, Grand Rapids Gas Light Co., Grand Rapids, Mich., excerpts from a description of the "Old Range Round-Up", presented before the Mid-West Gas Sales Conference, Chicago, Ill., February 10, 11, and 12, 1938.—(Abstract by G A S).**

EMBRYONIC plans for the first Old Range Round up for the Grand Rapids Gas Light Co., Michigan, were formed early last summer. It was planned for six weeks' duration from September 7 to October 16. Autumn was chosen since it is generally the best season for range sales. Successful "round-ups" in other cities were studied extensively.

Realizing the enormity of the task at hand, everyone in a supervisory capacity immediately took charge of a certain phase of the work.

These phases may be listed under the headings of: (1) dealer co-operation, (2) advertising, (3) salesmen's contest, (4) customer's old stove contest, (5) employee co-operation, (6) sales floor and office decoration, (7) home service, (8) refrigerator tie-in, (9) parade.

Several weeks before the opening date, all gas range dealers were approached by the dealer relations representative, who not only presented them with copies of a prospectus which explained in detail the purpose of the campaign and its benefits to the dealer, but the representative also read each paragraph with the dealer so that he would not pigeonhole it and dismiss it from mind.

In Grand Rapids, the regular allowance for an old range is 10 per cent of the cash installed price of the new one. During the Round-Up an additional $5.00 was allowed. It was understood by the dealers that at the end of the campaign the gas company would reimburse them to the extent of half of any extra $5.00 allowances made.

The prospectus to dealers outlined the allowance policy, told of plans for the parade, invited dealers to enter floats, and to take an active part in this event. It explained the customer contest on oldest ranges turned in, and the special contest for dealer salesmen. Entry blanks were left for participation in the Round-Up which automatically entered dealer salesmen in this contest. Window cards and trim were furnished to all dealers. Forty dealers responded with enthusiasm, and 15 entered floats in the parade. Co-operation on part of all dealers was splendid. In the final analysis, the 40 who entered accounted for 365 of our total range sales.

On the evening of Tuesday, September 7, the opening date, a dinner for the dealers was given in one of the local hotels. This was followed by a mass meeting for dealers, dealer salesmen, and all gas company employees. On this occasion the gas company sales personnel was garbed in cowboy hats and neckerchiefs presented that morning at the sales meeting. All dealer representatives were given scarfs to wear.

Sales Manager B. T. Franck, in wild west regalia, addressed the meeting with a speech which fired the audience with the true campaign spirit. He was followed by the guest speaker, Carl Sorby of the George D. Roper Corp., whose "Food Spoilage" act was greeted with enthusiasm.

The advertising program for this campaign was the most extensive ever used by the company. About two weeks before the opening date, "teaser" ads began to appear in the newspapers. These were single column, three-inch ads showing a cowboy on rearing horse, saying, "Yippee! I'll be seeing you at the Old Range Round-Up coming to Grand Rapids soon. Watch for announcements."

Opening day brought a double-page section of the evening paper with both dealer and gas company ads—the newspaper devoting 20 per cent of the space for Round-Up news items, and headlines featuring the mile-long wild west parade scheduled for the following Saturday. Sunday papers bore double-page spreads of dealer and

E. Carl Sorby, George D. Roper Corp., is shown as he presented his "Food Spoilage" act at the dealers' dinner on the opening evening of the Round-Up campaign.

gas company ads with reports of the parade, pictures, etc.

Twenty-two billboards were placed two or three days before the opening date at strategic points throughout the city, and advertising space was taken in all the city busses. Regular radio time was devoted almost entirely to Round-Up advertising during the entire six weeks.

Gas company service trucks bore two brightly colored signs—one with the rearing horse trade-mark, saying "Old Range Round-Up—Cash for old Stoves;" the other—"Wanted—Oldest Ranges—Reward."

All sales personnel, including members of the home service division and service men, were given ten-gallon hats and bright scarfs to wear at all times during business hours. Papier mache hats were used which were thrown away when soiled and replaced with fresh ones. The costumes had real advertising value. Many salesmen elaborated on the costume by making personal expenditure for bright silk shirts, and other items of wild-west apparel.

All salesmen's automobiles and company-owned passenger cars were equipped with bumper strips, front and rear, bearing the legend "Old Range Round-Up."

A movie "trailer," prepared especially for the local campaign was shown at downtown and neighborhood movie houses for the duration of the campaign.

Each range salesman was given a quota of 50 range sales. This quota was found to be a bit optimistic for a thirty-four-day campaign, although a few of the 24 salesmen reached this goal, and many others nearly did.

By September 7, the opening campaign date, the salesmen's room had been transformed into a ranch house. Cutouts of cowboys, on rearing horses, roping an old range, adorned the outside of the building which was surmounted by a huge flag bearing the Old Range Round-Up trade-mark. The sales floor was decorated with balloons and paper pennants, and a life-size wooden horse, saddled, bridled, was roped to an old range.

A huge board had been mounted on the wall which depicted a ranch with 24 corrals, one for each cowboy salesman. Each salesman's job for the Round-Up was to "cut out" 50 cows and herd them into his corral. In one corner of the room was a cashier's window with a sign, "Cattlemen's National Bank." For each cow corralled, representing a range order, the salesman drew from the pot at the bank window a coupon in a sealed envelope for an amount varying from 50 cents to $5.00, depending on his luck. These coupons, when properly countersigned by his supervisor and the sales manager, could immediately be cashed at the gas company cashier's window. However, if he sold nothing the first day of the campaign, he had 50 "cows" to feed, which cost him 25 cents.

At the end of each week, the high man in each of the three crews was rewarded by five extra draws from the pot, providing he had sold six or more stoves during the week.

A dinner was held at the end of the campaign at which members of the winning crew were guests of the losers. Competition was keen; only about a dozen sales separated the top crew from the bottom.

Customers' Contest

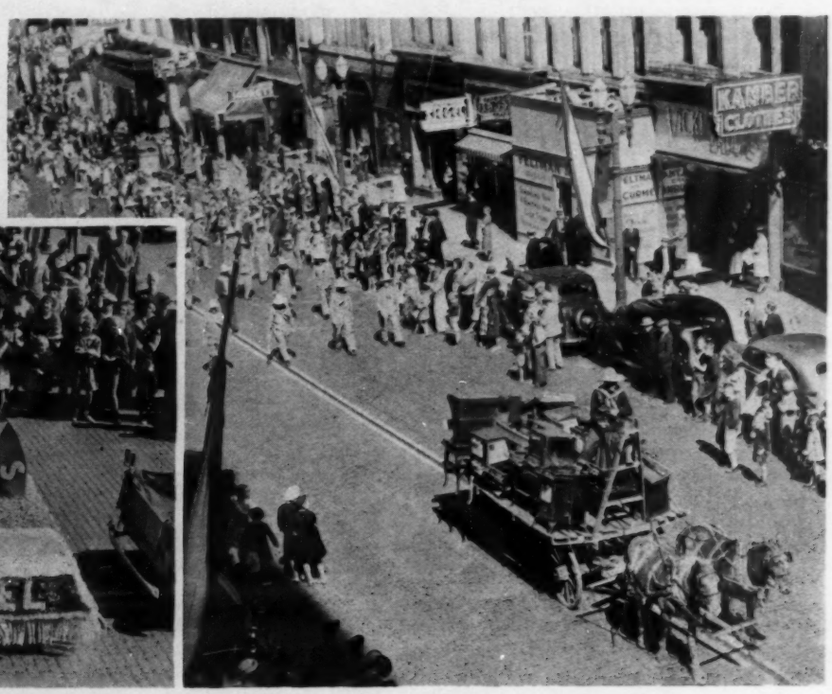
The first requirement to enter a customer in the Old Range Round-Up Contest was the purchase of a new gas range and the trade-in of his old one. The installation of the new range and return of the old one was required within 15 days after the closing date of the campaign.

Twenty-one prizes were awarded customers for the oldest gas ranges turned in. For the three oldest ranges, the new range was offered free. An old range to be eligible for the contest had to be in use at time of trade-in.

All old ranges, whether entered in the contest or not, were taken to the "Main Corral," a section of the service yard, located on the fourth busiest corner in the city. Here they were received, tagged, numbered, serial numbers and full data recorded by the chairman of the judging committee. Gas flood lights played on the old range pile by night. Pictures were taken periodically and published in the newspapers.

To stimulate the flow of prospects from non-selling employees, special awards for exceptional work were made in addition to the regular prospect bonus. An "auction party," announced in a bulletin issued to em-

BELOW IS SHOWN one of the 15 colorful dealer floats participating in the Wild West Parade, held during the "Old Range Round-Up" campaign, sponsored by the Grand Rapids Gas Light Co. AT RIGHT IS pictured horse drawn load of old ranges collected during the "round-up" while the "boys in blue denim," march behind in wild west regalia.



ployees the first day of the drive, was planned as follows: For each range prospect submitted which resulted in a sale, the employee received the equivalent cash value of the range in "stage" money. This was used for bidding on the merchandise articles which went on the auction block at the party. The party was held in the Home Service auditorium shortly after the termination of the Round-Up for possessors of Round-Up money only. The success of this party has assured the company of 100 per cent employee co-operation again next year.

The Home Service Division was a factor of singular importance. Well advertised floor demonstrations of modern gas cookery served to increase floor traffic. For the second week of the campaign, the services were secured of Frank Decatur White, famous culinary expert, sponsored by Detroit Michigan Stove Co. Cooking demonstrations were conducted in dealers' stores by the Home Service staff. Because of the season, home canning was stressed and recipes sent to hundreds of homes. Home calls were made on many prospects to assist the housewife in selecting her new range. The beef pies for the employees' contest and the thousands of cookies distributed at the parade were also the work of this division.

Many refrigerator sales were made from the Old Range Round-Up by issuing a check to all purchasers of ranges. These were delivered by the refrigerator salesmen and represented a 5 per cent discount on both appliances, plus $10.00 for trade-in of an ice box, providing the refrigerator purchase was made within 30 days after the range sale.

Wild West Parade

The wild west parade was the biggest single advertising item. It was held on Saturday, September 11, when the Round-Up was but four days old. Features of the parade included 60 cowboy and cowgirl riders, nearly all of whom were amateurs—employees who volunteered.

Five bands, spaced equidistant throughout the line of march provided the proper carnival air. All of the service trucks of the gas company participated and were spaced in blocks of 10 or 12, each bearing a modern gas range.

In addition to the 15 dealer floats, there were five by the gas company. One of these consisted of heavy duty equipment mounted on a stake-body truck. As an economic measure, the other floats which required more time to construct were built on old automobile chasses purchased for $10.00 each at a local auto wrecker and were towed by service trucks.

To promote juvenile interest, notice was made in the newspapers several days before the parade that any boys between the ages of 10 and 14 could march in the parade, that free "eats" would be furnished together with a real cowboy lariat to all who filled out the entry blank and appeared in cowboy or Indian costume at the gas company yard on Saturday morning. Cash prizes were offered for the best costumes. Results were overwhelming as hundreds of youngsters turned out in original costumes.

Ten thousand balloons bearing the Old Range Round-Up slogan were also distributed by salesmen who formed the rear guard.

Two horse-drawn hay-racks, piled high with old ranges, created a ripple of laughter from the crowd as they rumbled down the street. Ancient automobiles chugged a comparison between the old and the new.

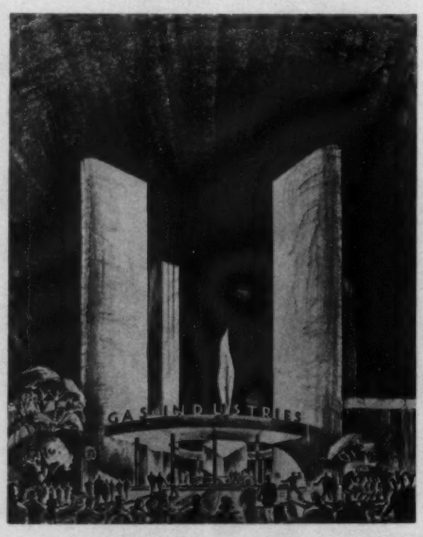
From the standpoint of straight publicity, the Grand Rapids Co. found the parade to have a more far-reaching effect than the mere advertising of the range campaign. The fanfare and color of the show served to give a "personality" to the campaign.

World's Fair Gas Exhibit Features "Court of Flame"

ONE of the outstanding displays at the New York 1939 World's Fair will be the majestic "Court of Flame," the focal point and main entrance to the gas industry's exhibit.

In the center of the Court, which is open to the sky, a ten-foot cube of glass resting on one of its corners will spiral skyward a perpetually flaming gas torch. Around this central motif, with its ring-like roof, will rise four 90-foot pylons, each wrapped in a wave of flame, symbolizing the fuel on which the whole gas industry is built.

At the base of the glass cube and grouped around the pylons, displays and models will show the scientific background, such as manufacture, refinement, storage and distribution, that makes possible the various utilizations of gas fuel.



The "Court of Flame" focal point and main entrance to the gas industry's $750,000 exhibit group at the New York 1939 World's Fair.

The industry's $750,000 exhibit group was designed by the firm of Skidmore and Owings, John Moss Associate, of New York and Chicago, for the non-profit corporation, Gas Exhibits, Inc., organized to conduct and manage the industry's participation in the Fair.

Adjoining the "Court of Flame," on one side, will be the main exhibit area for gas appliances of every description. Here the history of cooking throughout the rise of civilization will be portrayed. A graphic exhibit will demonstrate how refrigeration is produced by the heat of a gas flame. Old fashioned methods of heating will be vividly contrasted with the recent advances in the science of heating and air conditioning.

Because of the many phases of the gas industry which will be presented at the World's Fair, Hugh Cuthrell, president of the Gas Exhibits, Inc., and vice-president of the Brooklyn Union Gas Co., recently urged, in an address to the New England Gas Association, that gas companies tie-in their advertising and promotion with the World's Fair. Mr. Cuthrell suggested that the industry get its customers World's Fair-minded by showing the Fair and the gas industry's building and exhibits in window displays. In urging this collaboration on the part of New England gas companies, Mr. Cuthrell pointed out that the central heating, water heating, and cooking at the World's Fair will all be done by gas appliances.

The Certified Performance Gas Range

CONTINUING its march to better living and freedom from drudgery, gas now offers a new standard of performance in modern cookery through the sponsorship by a united gas industry of the C. P. (Certified Performance) Gas Range, to be specially built to specifications bringing forth the best virtues of gas.

The significance to the gas industry of the C. P. Range lies in the fact that for the first time the consumer has a means of identifying gas ranges that properly interpret gas values. The A.G.A. Laboratory has done meritorious services from a safety viewpoint and even in the matter of performance, yet the performance standards had of necessity to be minimum rather than optimum. Unfortunately, good cooking performance cannot be made to stand out in the appearance of the range. Because of this fact, it becomes necessary to establish certain cooking performance standards and to provide a means of identifying the gas ranges that meet these performance specifications. The C. P. Range fulfills this need.

Superior Performance Features

The C. P. Range stands for buying confidence on the part of the public. For the first time the public has a means of identifying a gas range with known performance qualities, now being assured of seven superior performance features: (1) cooking performance, (2) automatic features, (3) cool cooking, (4) speed, (5) economy, (6) convenience (7) cleanliness. There are 22 specifications on the C. P. Gas Range which produce the above seven improved performance features.

Better cooking performance is assured because of the specification that the oven must bake uniformly and because of the requirement that ovens must be capable of maintaining 250° F., insuring less shrinkage of meats and more tender foods. The giant burner insures quick, sustained vigorous boiling and the two-way top burners allow waterless cooking, low heat for simmering and sustained low boiling.

Automatic features of the C. P. Range include automatic oven temperature control, automatic top burner lighting, oven lighting, and broiler lighting, eliminating matches, push buttons or opening of oven doors to light burners.

● **HALL M. HENRY, assistant to the vice-president, The Utility Management Corp., New York, N. Y., and chairman of the American Gas Association subcommittee on the Certified Performance Gas Range in an address before the Mid-West Regional Gas Sales Conference, Chicago, Ill., February 10, 1938.—(Abstract by G A S).**

The cooler cooking feature is assured by new standards for insulation (average surface temperature is 30 per cent cooler than formerly), and by more efficient top burners and ovens so that less heat goes into the kitchen and more into the food. For quick heating results the time to bring oven to 500° F. temperature has been specified as 11 minutes. Oven broilers must heat up more quickly, and at least one top burner must have 12,000 B.t.u. input, enabling quick speedy boiling. These features produce 40 to 50 per cent faster results.

The customer is assured of more economical use of gas since the specifications require top burner efficiencies of at least 45 per cent.

Greater convenience is achieved with ball bearing drawers or equivalent, with finger tip control and effective stops to prevent accidental spilling. Fully automatic lighting, resulting in no stoop—no squat—no scratch, "click" top burners, and a simmering flame without peaking, are other convenience factors. Non-rusting burners, vents directed away from walls, and smokeless broiler pans assure added cleanliness.

To the manufacturer the C. P. Range means a unified sales theme of modern gas cookery which should stimulate more sales, a new sales appeal for the salesman, emphasis on performance rather than gadgets, and tremendous local and national publicity because of the news value of the C. P. Range program.

Significance to the Gas Industry

The C. P. Range means that gas fuel values will be properly presented to gas customers. It means our customers can distinguish between those ranges that give gas cooking standards and those that do not, thus making possible an effective unified national promotional cookery program. Better gas ranges will now be available to meet competitive fuel ranges.

Specifications for the C. P. Gas Range were developed by a special committee appointed by Herman Russell, past president of A.G.A., for the purpose of improving the quality of gas ranges. The first committee chairman was Hugh Cuthrell and members were representatives of gas companies and gas range manufacturers. The present chairman of the Committee for Improving Domestic Gas Appliances is N. T. Sellman.

The committee of utility and manufacturer representatives has been made responsible for the C. P. Range specifications and for the testing procedure to check compliance. These specifications have the approval of the Range Committee of the A. G. A. E. M. and of the A. G. A. E. M. and A. G. A. Boards, which makes them the official specifications of the gas utilities and the range manufacturers. To check on requirements, the range manufacturer may send his range to any reputable and established laboratory, such as that of a commercial testing laboratory or of a university, or at the A. G. A. Laboratory. The manufacturer is responsible for his ranges meeting the C. P. specifications.

Promotion Plans

Funds for national promotion of the C. P. Range will be obtained through the licensing of a C. P. Monogram to manufacturers for a small sum per C. P. Monogram used. The funds will be paid into the A. G. A. E. M. treasury and ear-marked for C. P. Range promotion, which will be a part of the work of the standing Range Committee of A. G. A., of which Frank Houston, Rochester Gas and Electric Co., is chairman. To insure special and intensive promotion of the C. P. Ranges, a sub-committee of the Range Committee has been set up with the writer as chairman. The representation on this committee which will focus national and local attention on the C. P. Range, is composed of utility men and gas range manufacturers. Activities in various sections of the United States will be carried on by regional and state chairmen. The Range Committee of the A. G. A. E. M. through its promotion sub-committee will cooperate in the C. P. Range promotion.

No C. P. Ranges will be available before August 1, 1938. This date has been advanced from March 1 to August 1 to give ample opportunity for manufacturers to get their ranges certified and to allow ample time for the utilities to become thoroughly familiar with the C. P. Range Program.

Program Set for P. C. G. A. Spring Conference

THE Technical Section of the Pacific Coast Gas Association will hold its Spring Conference on April 7 and 8 at the home office of the Southern California Gas Co., 810 So. Flower St., Los Angeles, Calif. Arthur B. Allyne, formerly chemist with the Southern Counties Gas Co. and now affiliated with the California Railroad Commission, is general chairman of the Technical Section.

Parallel sessions of the Utilization, Transmission, and Distribution Committees will be held on each day of the meeting. The Production Committee will meet during the Friday morning session. The conference will close with the entire group meeting in general session.

Each of the two days of technical discussions will be broken by group luncheons, and two capable and entertaining speakers, Gene Coughlin, sports editor of the Los Angeles *Evening News* and Jack Hinds, Hollywood property man, will feature the luncheon meetings.

The program for the two-day conclave as released by Clifford Johnstone, managing director of the Association, follows:

TUESDAY MORNING

9:30 a. m.

Opening Remarks, A. B. Allyne, general chairman.

PARALLEL MEETINGS

9:45 a. m.—12:00 m.

Transmission Committee

F. E. Wilson, chairman

Large Volume Measurement, G. B. Reece, chairman.

(a) "Operation and Maintenance of Orifice Meters," M. J. Cereghino.

(b) "Proving Displacement Meters in the Field with a Low Pressure Flow Prover," F. H. Winslow.

(c) Discussion — Pulsation, Pressure Multipliers, Handbook for Displacement Meter Measurement.

Room No. 930.

Utilization Committee

R. I. Snyder, chairman

Appliance Laboratories, J. P. Dresen, chairman.

(a) "Operating Efficiency of Pilots on House Heating Equipment," J. P. Dresen.

(b) Discussion — Warehouse Inspection of Refrigerators.

10:30 a. m.—12:00 m.

Inspection of New Appliances, C. A. Renz, chairman.

Room No. 923.

Distribution Committee

H. G. Laub, chairman

ARTHUR B. ALLYNE

CLIFFORD JOHNSTONE

Special Problems, Frank Wills, chairman.

(a) "Odorization by Integrating Orifice Gages," C. F. Briscoe and H. G. Caldon.

(b) "Practical Considerations in the Application of Thermometer Calibration Corrections," B. M. Laulhere.

(c) Discussion of Dust Problems.

Room—Auditorium.

Group Luncheon

12:15 p. m.

Speaker: Gene Coughlin, Sports Editor, Los Angeles *Evening News*. Subject: "How a Sports Writer Would Run a Gas Company."

THURSDAY AFTERNOON

PARALLEL MEETINGS

2:00 p. m.—5:00 p. m.

Transmission Committee

2:00 p. m.—3:45 p. m.

Compressor Plants, A. B. Newby, chairman.

(a) "Effect of Large Valve Areas on Compressor Performance," W. C. Collyer.

(b) "A Study of Pressure Drops in Typical Compressor Stations," O. A. Philpott.

(c) Discussion — General Operating Conditions.

3:45 p. m.—5:00 p. m.

Pipe Protection, C. F. Briscoe, chairman.

(a) "Insulation of Structures Connected to Cathodically Protected Pipelines," H. J. Keeling.

(b) Discussion—Effect of Tree Roots on Coatings, Windmills for Pipe Protection, Effect of Soil on Asphalts.

Room No. 930.

Utilization Committee

2:00 p.m.—2:30 p. m.

Air Conditioning, Glen Miller, chairman.

(a) "Application of Gas to Summer Air Conditioning," Glen Miller.

2:30 p. m.—3:00 p. m.

Architects Data Book, Frank Moon, chairman.

3:00 p. m.—5:00 p. m.

"Standardization of Appliance Installations," C. E. White, chairman.

Discussion—Flexible Connections, Requirements for House Piping and Appliance Installation.

Room No. 923.

Distribution Committee

2:00 p. m.—3:30 p. m.

Construction and Maintenance, C. P. de Jonge, chairman.

(a) "Maintenance of Combustible Gas Indicators," F. R. Bater.

(b) "Acetylene Welding on Live Gas Mains," N. L. Hoff.

(c) "Metallurgical Study of Welds," N. K. Senatoroff.

(d) Discussion—Service Truck Equipment.

3:30 p. m.—5:00 p. m.

Measurement and Regulation, H. A. Faull, chairman.

(a) "Design of a Remote Control Pressure Regulating Station," W. A. La Violette.

(b) Discussion—Materials for Valve Covers and Seats, Testing Meters at Low Rates of Flow.

Room—Auditorium.

FRIDAY MORNING

PARALLEL MEETINGS

9:30 a. m.

Transmission Committee

9:45 a. m.—11:00 a. m.

Transmission Pipe Lines, R. T. Peterson, chairman.

(a) "New Dewpoint Apparatus," A. B. Martin.

(b) "Gas Temperatures in Transmission Pipe Lines," J. B. Reddick.

(c) Discussion — Pipe Line Hydrates, Dehydration, Design of Pipe Line Anchorages, Operating Economies.

Production Committee

J. E. Kelley, chairman

11:00 a. m.—12:00 m.

Butane-Air Plants, A. R. Bailey, chairman.

(a) "Butane-Air Standby Plant for Emergency Use," M. C. Gould, mechanical engineer.

Room—Auditorium.

Distribution Committee

9:45 a. m.—12:00 m.

Employee Training, B. F. Embry, chairman.

(a) "Employee Training in Butane Plants," J. Koeneman.

(b) "Industrial Training," W. C. Dodder.

(c) "Gas Engine Servicing," C. L. Ferry.

(d) Discussion — Training Questionnaire, Sampling Customer Reactions.

(Members of the Utilization Committee are invited to attend the above meeting and participate in the discussions.)

Room No. 930.

Group Luncheon

12:15 p. m.

Speaker: Jack Hinds, Hollywood's Premier Property Man. Subject: "Gath-

(Continued on Page 78)

Pacific Coast Gas Association

Technical Section

A. B. ALLYNE, General Chairman

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Use of Integrating Orifice Gages in the Odorization of Gas in Pipe Line Systems

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THE odorizing of natural gas to be used for domestic and industrial purposes is now generally recognized throughout the industry, to be a very desirable safety precaution. As a matter of fact, legislation by some states has made the practice mandatory. With this better appreciation of the advantages of odorization and the pressure of legislation and sentiment has appeared a growing interest on the part of engineers in regard to the design of the necessary equipment to perform the operation. While it has long been the practice of the Southern California Gas Co. and its associated companies to odorize the gas handled in its system, the search by its engineers for a universally applicable method of injection has never been entirely satisfied. However, it is felt that in the development of the system under discussion in this paper, a most accurate and flexible means of control for unstable gas flow has been effected.

In order to establish a basis upon which a comparison of the relative merits of the odorizer herein introduced may be made with other systems in general use, a brief review of common types of apparatus has been included. Odorization apparatus in its present state of development may be conveniently classified into two major types, by-pass and liquid injection.

By-Pass Odorizers

As would naturally be deduced from the name, this type of apparatus consists essentially of a by-pass around a short section of the main line together with the necessary odorant storage reservoir and valves for controlling the proportion of gas to be taken from the main line, saturated with odorant and returned to the gas stream. Some of the most popular by-pass odorizers include the following subtypes, simple diffusion, wick and liquid seal. Referring to Fig. 1 which is a diagrammatical sketch of a simple diffusion type of odorizer, it will be noted that the portion of the gas stream to be saturated with odorant is caused to flow through the by-pass arrangement as indicated by pinching valve A. The volume of by-pass gas enters the odorizer at point 1, passes over the surface of the liquid odorant where it becomes saturated or partially so with the vapor, then leaves the chamber at point 2 and reenters the main flow of gas. Suitable baffles may be installed to effect better flow control or contact at the gas-liquid interface. This type of odorizer has the advantage of simplicity and ease of regulation for a set condition. However, the rate of vaporization of odorant into the gas stream is affected considerably by temperature fluctuations; the control for varying gas flow volumes is sometimes difficult. In connection with the adjustment of this type of apparatus, the reader is referred to an article by T. S. Whitis[1] on the subject.

Passing to Fig. 2, a sketch of one type of wick by-pass odorizer, one will note that the volume of by-passed gas is also controlled by adjustment of valve A. The by-passed gas, in flowing through the by-pass, passes over a wick which due to its immersion in the liquid is saturated with odorant which evaporates into the gas stream. The odorized gas then reenters the main line and is diluted to the desired concentration. This type of device compares favorably with that shown in Fig. 1 but may give some difficulty due to wick clogging and control for unstable gas flow.

In Fig. 3 is shown the liquid seal type of by-pass odorizer. The ratio of by-passed to total gas flow is regulated by adjustment of valve A. The gas to be treated passes into the odorizer and bubbles through liquid odorant via the inverted nozzle (1), thence into chamber (2) and leaves the apparatus at (3) whence it re-enters the main line. For detailed information on this type, those interested are referred to an article by Robert M. Hutchinson.[2] This system has the advantage over the previously mentioned by-pass odorizers of a more intimate gas-liquid odorant contact which insures a higher degree of saturation. However, the effect of fluctuating odorant vapor pressure with temperature still exists especially if the device is subjected to the weather without protection. The Whitis system of adjustment could be applied to this apparatus but slight alteration in the piping arrangement would be necessary.

Before leaving the by-pass type of odorizer, it is interesting to study the effect of pressure fluctuations on the rate of vapor injection. Assuming the adjustment is made under a given pressure condition, then regardless of the pressure change within reasonable limits, the proportion of gas by-passed would be the same. However, since the solubility of an odorant is inversely proportional to the absolute pressure, the degree of odorization would fluctuate inversely with the pressure. This might be critical under some conditions.

Liquid Injection Odorizers

The principal of operation of the liquid injection type of gas odorizer as implied by the name involves the injection of odorant in the liquid form directly into the gas stream and its subsequent vaporization in the pipe line. For the purpose of comparison, this class of equipment has been classified into three general types, lubricator, differential controlled

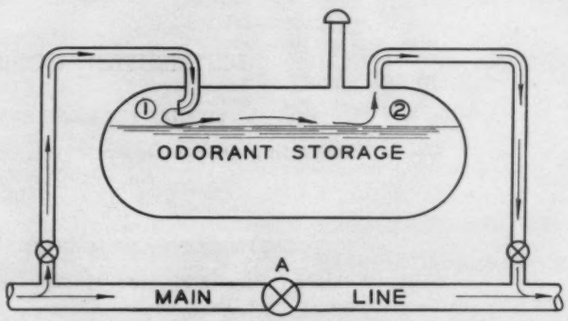

FIG. 1. By-pass odorizer, simple diffusion type.

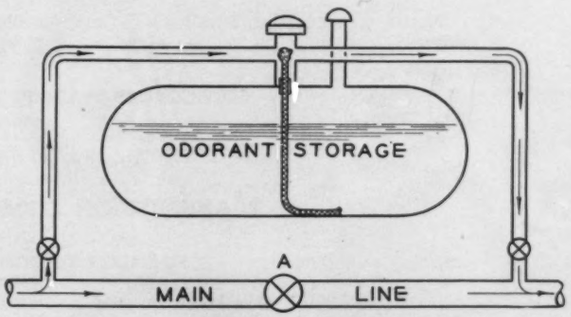

FIG. 2. By-pass odorizer, wick type.

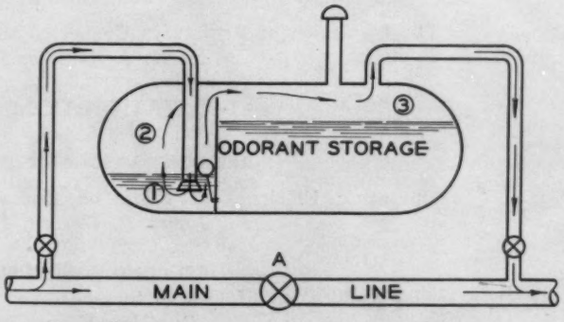

FIG. 3. By-pass odorizer, liquid seal type.

*A Report of the Special Problems Subcommittee, Distribution Committee, Technical Section, Pacific Coast Gas Association.

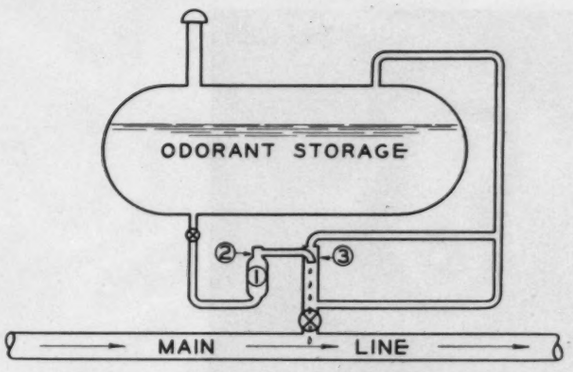

FIG. 4. Liquid injection odorizer, lubricator type.

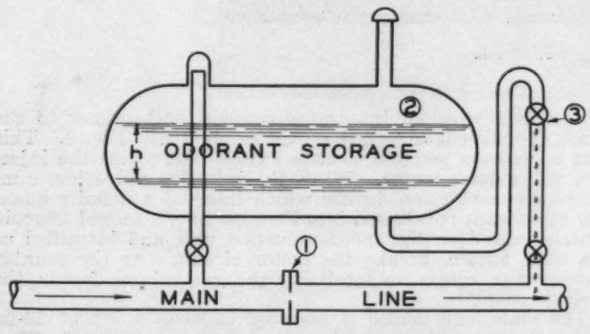

FIG. 5. Liquid injection odorizer, differential controlled type with varying liquid head.

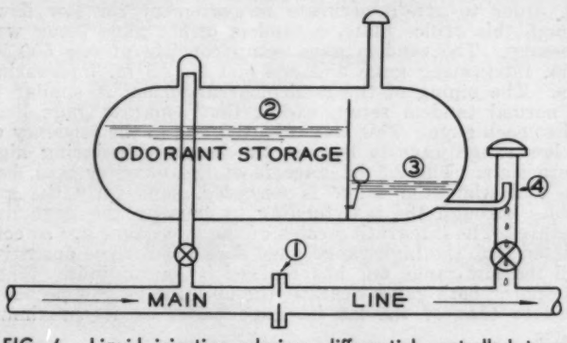

FIG. 6. Liquid injection odorizer, differential controlled type with constant liquid head.

and that described in this paper and identified as the pressure-differential controlled type.

In Fig. 4 is shown one arrangement of the lubricator type, the design of which is after that developed by Bruce Mac Cannon.[3] Mr. Mac Cannon includes in his design an ingenious feed control consisting of a ceramic filter through which the odorant is allowed to percolate in order to maintain control of the small quantities handled. The device appears to have merit for the purpose for which it was developed, that is for small loads in isolated areas. It might also be used effectively on larger stations where the pressure and differential fluctuations do not vary over a wide range. The principle of operation involves the feeding into the gas stream of liquid odorant from the storage tank through the ceramic packed filter (1) into the odorizing chamber (2) and thence through the nozzle (3). The degree of odorization in this device is practically independent of the temperature but may be seriously upset where wide gas volume fluctuations occur.

Fig. 5 shows one type of differential controlled device wherein the head of liquid odorant on the adjusting orifice varies between the limits indicated by "h." This setup requires the insertion of an orifice in the main line which produces a differential pressure across an adjustable liquid odorant orifice. The pressure on the high side of the main line orifice (1) is communicated to the space (2) above the liquid odorant in the storage tank, while that of the low side is impressed against the outlet of the adjustable orifice (3). This type of apparatus has been found to yield satisfactory results for small properties and if constructed so the dimension "h" is small as compared to the main line differential, it maintains an acceptable calibration for varying flow rates. It has the advantage over that shown in Fig. 4 of a zero injection rate, for no gas flow. For all practical purposes, the degree of odorization is also independent of temperature effects upon odorant solubility in the gas stream.

In Fig. 6 is shown the constant head type of differential controlled odorizer. The Southern California Gas Co. has a number of this design in service and has found them to be acceptable from both the standpoint of calibration and general operation. However, this type is not suitable for a varying pressure condition as an increase in pressure, over that at which the rate was adjusted, results in underodorization whereas a drop causes an overdose to be administered. The principle is as follows: An orifice installed at (1) causes a differential pressure to be impressed on a liquid orifice (4). The liquid orifice is located so the point of odorant discharge is slightly higher in elevation than the level (3) which is maintained at a constant height by means of a float regulating the flow from the odorant storage section (2). The orifice (4) may be fixed or adjustable and once the proper ratio of odorant orifice area to the main line gas orifice area is established, the apparatus remains in satisfactory calibration as long as the static pressure is constant.

Time and space will not permit of reference to many other designs of odorizers but for those who may not be familiar with the literature on the subject, for a treatise on atomizing and wick odorizers, the reader is referred to P. E. Beckmans' contribution on the subject.[4] This article contains interesting data on a wick type and an atomizing liquid injection type together with properties of odorants and other useful data. The atomization of odorant injected by the pressure-differential controlled odorizer would facilitate the vaporization of the odorant but to date operations have not indicated that this is necessary for the installation described in this paper.

The Pressure-Differential Controlled Odorizer

The pressure-differential controlled odorizer was designed to meet a condition for which, a thorough search of the market revealed, no suitable standard equipment was available. The requirements dictated that the apparatus be capable of treating gas flows in a single pipe line varying from a maximum of 200,000,000 cu. ft. per day to a minimum of less than 5,000,000 cu. ft. per day. This fluctuation is accompanied by pressure changes ranging from a maximum of 300 lbs. per sq. in. to a minimum of 100 lbs. per sq. in. under normal operating conditions.

Since the liquid injection method seemed to be the most readily applicable to the solution of the problem, the design was built around that principle. In selecting a means of injection control which would maintain its calibration in regard to the odorant-gas ratio, the integrating orifice gage was chosen. With the aid of this device, which was readily obtainable on the market, it was realized that the problem became one of simply supplying a means of operating a positive displacement device to handle the liquid odorant from

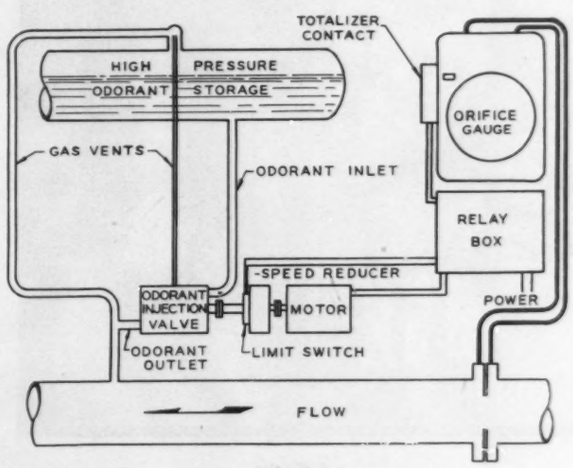

FIG. 7.

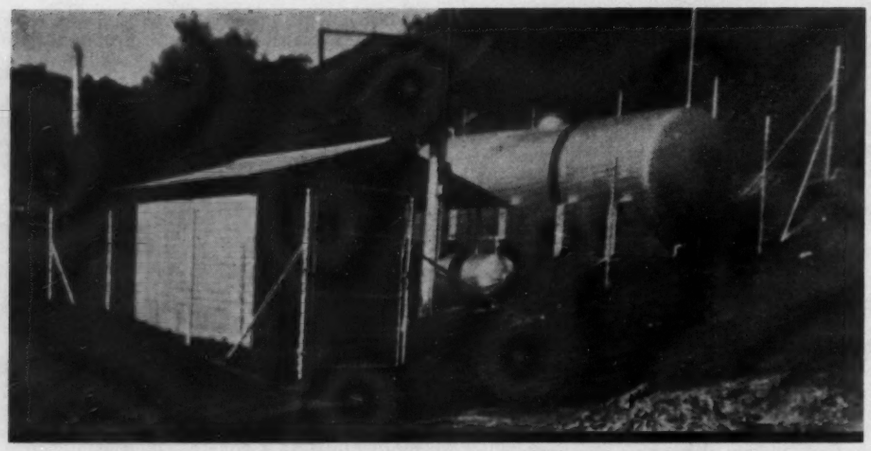

FIG. 8. Pressure, differential controlled odorizer.

storage into the pipe line. It would, of course, be necessary to operate the injection device in a lineal relationship with the rotation of the integrating counter.

In order to prove the feasibility of the plan, a small positive displacement slide valve was made for laboratory tests. The displacement of this experimental valve was 1.125 cu. in. and when assembled with its operating solenoid, relays, integrator counter contacts and incidental piping, was found to perform the function with entire satisfaction.

Based on this experiment, approval was given to proceed with the design and construction of the full scale apparatus shown in Fig. 7. This photograph shows a general view of the station which is located near the Newhall tunnel some 30 miles north of Los Angeles. At this point the Southern Fuel Company's 26 inch pipeline crosses the Newhall mountains and enters the northern end of San Fernando Valley. The location is particularly suitable with respect to ease of gravity handling of the odorant, as well as isolation from surrounding residences and other structures.

In Fig. 8 is given a diagrammatic sketch of the arrangement of the several units comprising the pressure-differential controlled odorizer shown in Fig. 7. The sequence of operation is as follows: The gas is measured through an orifice meter and recorded on an integrating orifice meter gage. The gage is equipped with an integrator counter or totalizer to the shaft of which is attached a cam as shown in Fig. 9. This cam operates a mercoid electric switch that starts the injection valve drive motor. When the injection valve has completed one revolution during which interval a definite quantity of odorant is released into the pipe line, a second mercoid switch located on the speed reduction unit and identified as the limit switch, breaks the motor circuit. As the counter continues to rotate, in totalizing the gas volume factor, the cycle is repeated.

The main line orifice is inserted between a set of 26-in. orifice flanges which were installed in the existing pipe line. This orifice is capable of measuring a maximum of 200,000 M cf. per day at 200 lbs. per sq. in. gage pressure.

In order to attain accurate measurement for low flows through this orifice plate, a tandem orifice gage setup was necessary. The tandem gage setup consists of one 500 lb. 50 in. integrating gage and one 500 lb. 2.5 in. integrating gage. The piping of the tandem arrangement is similar to the normal tandem setup, except that separate gage lines lead to each gage. This was essential due to the tendency of the low range gage to by-pass the larger one during high differentials. The 2.5 in. gage is of the mercury seal, bell type and when the range is exceeded, sufficiently the gas bubbles through the seal tending to equalize the gage line pressures. The integrating cams of the two gages are so constructed that the high range gage does not become operative until the low range one has reached its outer limit. When this occurs, both gages operate, the 50 in. gage volume being added to that of the 2.5 in. gage based on its maximum range.

Each of the gages just described is fitted with a totalizer contact which operates its respective injection valve. The displacement of these two injection valves is approximately .200 gal. and .900 gal. respectively for the 2.5-in. and the 50-in. gages.

A sketch of the smaller injection valve to be used in conjunction with the 2.5-in. gage is shown in Fig. 10. In calculating the displacement of this valve the general equation, applicable to any orifice meter using logarithmic charts, was used.

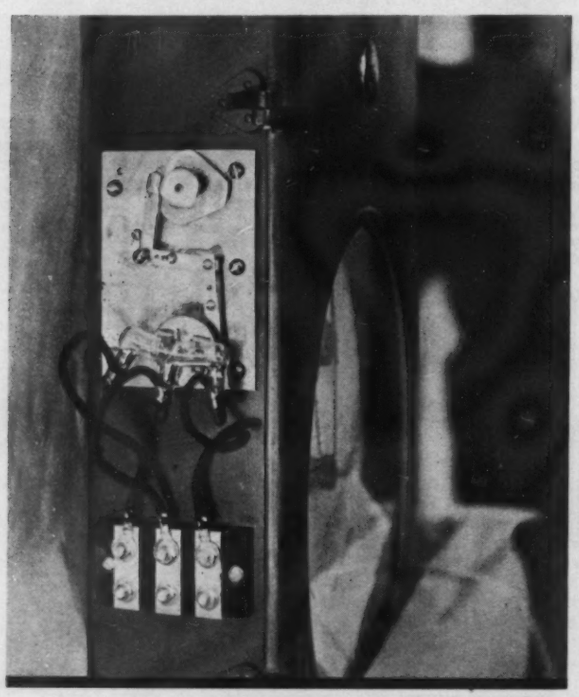

FIG. 9.

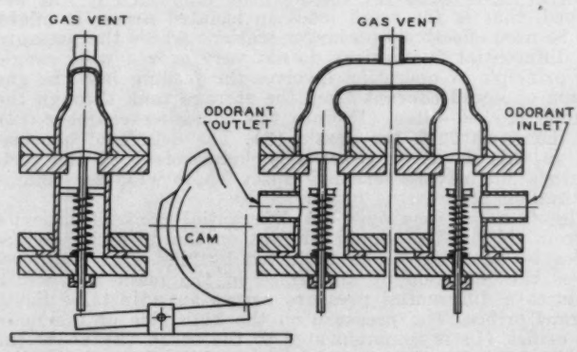

FIG. 10. Poppet type injection valve.

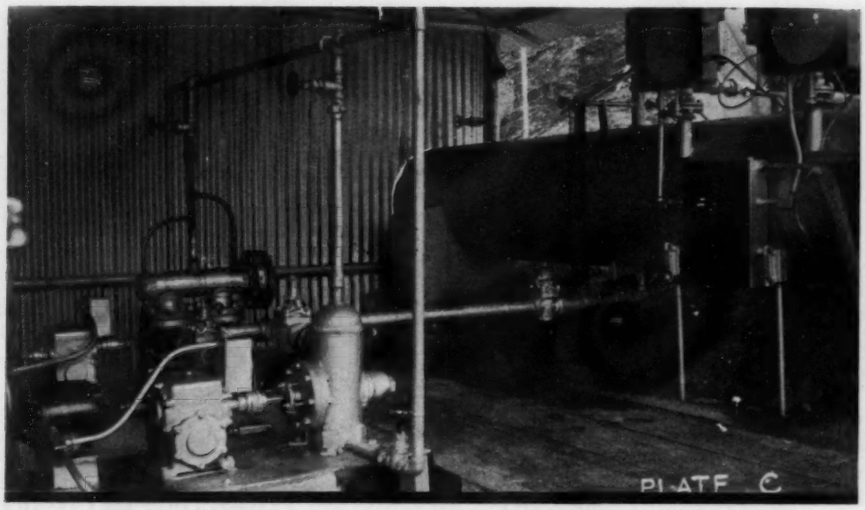

FIG. 11.

$$q = \frac{OQ \times 10}{h_s P_s N}$$

Wherein:

q = Displacement of injection valve per revolution.
O = Degree of odorization in gals. per million cu. ft.
Q = Hourly gas flow in millions of cu. ft.
h_s = Differential indication on log chart.
P_s = Pressure indication on log chart.
N = Number of injections to be made per revolution of the totalizer.

Suppose for example the following conditions exist.

O = 2 gals. per million cu. ft.
Q = 500,000 cu. ft. per hr.
h_s = 3.0
P_s = 5.75

Assume further that it is desired to make one injection per revolution of the totalizer. The number of injections possible to make per revolution depends upon the time required for the mechanism to discharge and refill, this interval is controlled by the constructional features of the valve. In the valve under discussion the inlet valve is open for six seconds and after closing, the discharge valve is open eight seconds.

Proceeding with the calculation:

$$q = \frac{2 \times 0.5 \times 10}{3.0 \times 5.75 \times 1} = 0.58 \text{ gals.} = 134 \text{ cu. ins.}$$

The cams on the injection valve drive shaft may be located so the device will fill immediately after dumping or just previous to the following injection. If allowed to stand empty between operations there is less possibility of leakage should the valves fail to seat properly. Since the springs in these valves are very heavy and there is an unbalanced condition with respect to inside and outside pressure, the valve seated is very positive especially for high pressure operation.

One fourth horse-power motors are used in conjunction with 1500 to 1 speed reduction units to drive the injection valves. This is considerably more power than needed but these motors being already on hand, were used.

The general arrangement of the high pressure odorant storage tank, tandem orifice gages and odorant injection valves is shown in Fig. 11. The pipe line is lower in elevation than the valves so the odorant flows freely from the former to the latter under the influence of gravity. The injection unit in the foreground is the rotary type valve, the construction of which is shown in Fig. 12. This type of valve has performed satisfactorily and would be ideal for

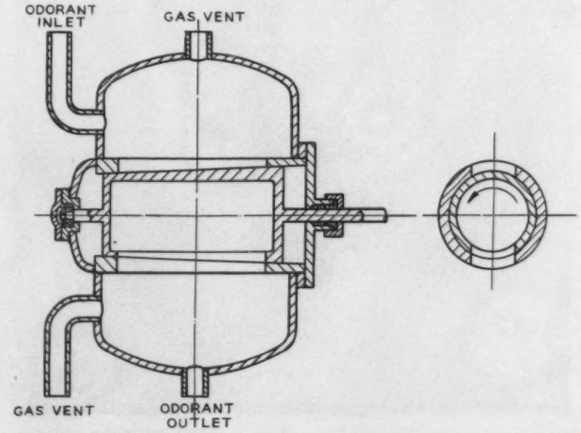

FIG. 12. Rotary type injection valve.

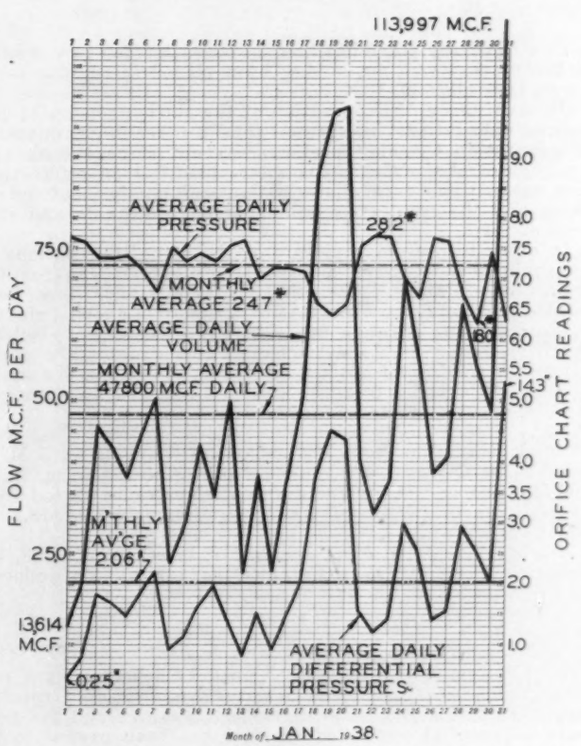

FIG. 13.

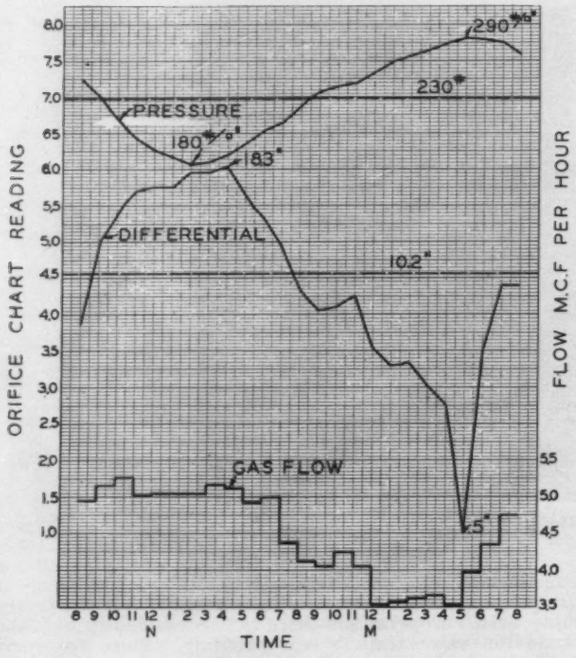

FIG. 14.

small setups. However, due to the accurate machine work necessary to insure this valve against leakage, in large sizes, it will be replaced by the poppet type valve, Fig. 10. This valve is simple and less expensive in construction; and would be more easily serviced in the field if leakage should develop.

The storage facilities are readily identified in Fig. 8. The large tank, under atmospheric pressure, has a capacity of 4,500 gallons. This tank is located at an elevation two feet above that of the high pressure storage tank which is constructed of 26 inch line pipe and has a capacity of 910 gallons. These combined capacities will take care of normal loads over approximately a three weeks' period.

Operating Data

This odorizing plant has been in operation for two months at the present writing, having been placed in regular service on December 29, 1937.

Observations on the operation of the station consist of gas volume calculations, integrator totalizer readings, quantity of odorant in the high pressure odorant storage tank and readings of the revolution counters installed on each injection valve. The data allows a thorough analysis of operations, and the results are tabulated on a suitable and convenient form.

In order to present a picture of the actual fluctuations in gas volumes, pressures and differential pressures for the month of January, 1938, the average values have been plotted in the chart, Fig. 3. Inspection will show a change in volume over a range of from approximately 13,000,000 cu. ft. per day to 114,000,000 cu. ft. per day. The static pressure varied from 180 lbs. per sq. in. to 282 lbs. per sq. in. and the differential pressure changed between the limits of 0.25 in. of water to 14.3 in. of water.

Fig. 14 shows a typical day's operating conditions with volume fluctuation from 3525 M cf. per hour to 5275 M cf. per hour. The pressure ranged from 180 lbs. per sq. in. to 290 lbs. per sq. in. and the differential pressure varied from a minimum of 0.5 in. of water to a maximum of 18.3 in. of water.

During the period from January 1, to March 1, 1938, the rate of injection was maintained at 1.9 gals. of odorant per million cu. ft. of gas passed.

Summary

In reviewing the subject, the authors believe that a new development has been made in natural gas odorant injection apparatus. There is a need for such a device and the pressure differential controlled odorizer has been proved to the point where it is available to the industry without further expensive experimentation. Odorization with this equipment has been maintained for the two months of operation of the plant described to within 5% of the desired concentration.

In closing, the authors wish to express their gratitude to Messrs. H. P. George and W. M. Pipkin, Manager of Operations and Superintendent, respectively, of the Southern Fuel Company, and to Messrs. S. S. Donaldson and M. T. Burton of the Southern California Gas Company for their interest and cooperation in the development of the apparatus introduced in this paper.

REFERENCES

1. *By-pass Odorizers—Their Direct and Accurate Adjustment* by T. S. Whitis, *G A S*, January, 1938.
2. *The Liquid Seal Principle Applied to Odorization* by Robert M. Hutchinson, *G A S*, November, 1937.
3. *Natural Gas Odorizing Equipment for Small Properties* by Bruce MacCannon, *Gas Age Record*, January 7, 1937.
4. *Atomozing and Wick Odorizers* by Philip E. Beckman, *Western Gas*, December, 1930.

Fillet Welding on Steel Pipes under Moderate Internal Pressures

By NORMAN L. HOFF

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IT IS common practice among pipe line operators to weld off-take connections to pipe lines without removing the line from service. There is, however, a rather surprising lack of agreement as to the safe limits of pressure under which this practice may be condoned. With the exception of the recent work of Wilson[1] there seems to have been little or no effort made to establish criteria upon which these limits might be based.

In the following discussion certain experiments, mostly of a practical nature, are described, which it is hoped will be the forerunner of more careful and comprehensive tests in this field of research. No attempt is here made to cover the entire field of welding, but only that phase which treats of the making of fillet welds on small pipes under moderate internal pressures, or conditions which normally prevail in gas distribution practice.

Experiments with Air

The mathematical theory of the stresses to which a pipe is subjected during welding under pressure is quite complex, and as shown in the appendix does not lead to a solution upon which we can with confidence rely. Because of the element of doubt, experiments were first conducted upon pipes containing air. For this purpose a piece of 3-in. light weight, grade B, seamless tubing, having a wall thickness of

*A Report of the Construction and Maintenance Subcommittee, Distribution Committee, Technical Section, Pacific Coast Gas Association.

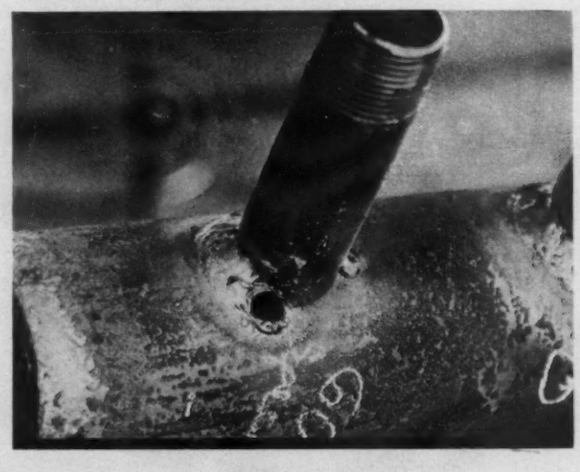


FIG. 1.

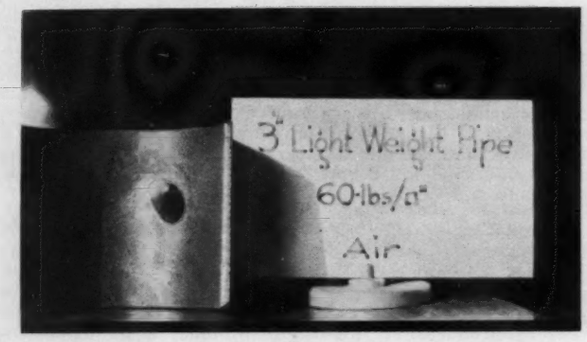


FIG. 2.

0.148 in., and being about four ft. long, was constructed into a manifold with suitable inlet and outlet connections.

Air under pressure was conducted to this manifold from a source where pressures up to 100 lbs. per sq. in. were available. Since it is desirable to experiment under the most unfavorable conditions likely to be encountered in practice, conditions were adjusted so that there was a barely perceptible flow of air through the manifold. Obviously, if the air flowed with great velocity past the weld, a most desirable cooling influence would be exerted.

With the pressure adjusted to 50 lbs. per sq. in. in the manifold, a standard one-in. nipple was welded on to the top of the manifold using the neutral flame oxy-acetylene process, a No. 6 welding torch tip and six-lbs. per sq. in. oxygen and acetylene pressures. During the course of the welding no unusual phenomena were observed, and at completion the weld was judged to be satisfactory in every respect.

Increasing the manifold pressure by increments of 10 lbs. per sq. in., one-in. standard nipples were successively, and successfully, welded on to the top of the manifold, up to and including a manifold pressure of 90 lbs. per sq. in. While the pressure was still at 90 lbs. per sq. in., another welder of less skill and experience than the first was called in to make a weld. This he proceeded to do without mishap.

The pressure was then reduced to 60 lbs. per sq. in., and the welder instructed to increase his normal penetration until he judged it to be equivalent to half the wall thickness of the pipe. Under these conditions the nipple was welded on as successfully as before.

With the manifold pressure remaining at 60 lbs. per sq. in., the welder was instructed to make another weld, and to increase gradually his penetration until failure of the pipe wall occurred. As might be expected, the blow-out was accompanied by a considerable shower of sparks, resulting from the burning of the molten metal by the oxygen of the escaping air. Figs. 1, and 2 show various aspects of this blow-hole.

It is especially interesting to observe in Fig. 2 a sort of ledge extending back under the completed portion of the weld indicating, possibly, that there may have been a situation a short time before failure occurred when a molten puddle existed on the inside as well as the outside of the pipe.

By visual examination it is practically impossible to judge whether or not a weld of this kind has been properly fused into the pipe wall. The welder, in his anxiety to prevent a blow-out, might be inclined to be a little careless in this regard, thus producing an inferior weld. In order to be sure that proper fusion was achieved on these welds, the manifold was placed in a vise and the welds tested to destruction. This was done by striking the nipple with a heavy hammer. With the exception of the first weld, at 50 lbs. per sq. in., failure in each case occurred in the parent metal of the nipple. The welder afterward admitted that he gained confidence as he proceeded.

Experiments with Natural Gas

It has been known for some time that a carburized ring forms on the inside of a "live" gas line, directly beneath the weld. This doubtless results from a breaking down or cracking of the hydrocarbon constituents, causing a deposition of carbon, which is subsequently absorbed by the heated metal by the process of carburization. Moreover, it has been frequently observed that nodules (Fig. 7) or ridges are formed in this carburized area. Chemical analysis discloses that these nodules have a high carbon content; visual inspection would indicate the possibility of these mounds being formed as a result of the metal on the inside of the pipe becoming molten or semi-molten. In order to test this theory a number of welds, including two oxy-acetylene "Speed Welds," were made on a manifold containing natural gas under a pressure of about one lb. per sq. in. Some of these welds were then cut out, polished, etched and examined under the microscope. It was discovered that these nodules had quite definitely been in the molten or semi-molten state, since dendrites were plainly present in their structure.[2]

We must recognize, therefore, the possibility that two molten puddles may exist, one on each side of the wall of the gas line, while welding is in progress, and must assume that risk of failure of the pipe wall due to the internal pressure is greater in the case of welding on "live" gas lines than on "live" air lines under similar pressures.

In order to determine the seriousness of this internal carbonization, the following experiment was conducted. A manifold of 3-in. light weight, grade B, seamless tubing, similar to that used on the air experiments was constructed. Natural gas under pressure was piped to the manifold from a source where pressures up to almost 80 lbs. per sq. in. gage were available. As before, conditions were so adjusted that a barely perceptible flow of gas was passing through the manifold. By means of throttling valves the pressure in the manifold was first set at 10 lbs. per sq. in., and a standard pipe nipple welded on at that pressure. Nothing unusual was noted. The pressure was then raised in steps of 10 lbs. per sq. in. until finally the inlet valve was opened wide, giving the maximum pressure available with the set-up. Thus, nipples were welded on to the top of the manifold at each of the following pressures: 10, 20, 30, 40, 50, 60, 70 and 77 lbs. per sq. in. In all cases the welds were made without difficulty, using the standard oxy-acetylene process, No. 5 torch tip and 5 lbs. per sq. in. oxygen and acetylene pressures.

The pressure on the manifold was then lowered to 50 lbs. per sq. in., the torch tip changed to a No. 6 and the oxygen and acetylene pressures raised to six lbs. per sq. in. A nipple was then welded on at this pressure, taking an unusually deep penetration, welding slowly, interrupting the welding at frequent intervals and allowing the metal to cool, and utilizing an unusually large flame on the torch. The purpose of this test was to imitate, in a measure, conditions which might occur if an inexperienced or careless welder were making the weld. Notwithstanding the rigorous conditions artificially set up, the weld was made with entire success. With conditions the same, except that the torch tip was changed to a No. 5, the pressure was raised to the maximum (76 lbs. per sq. in.) and the test repeated. Still no difficulties were encountered, and the weld was found satisfactory when tested to destruction.

The pressure on the manifold was then reduced to 50 lbs. per sq. in., and the welding penetration gradually increased until failure occurred. Unlike the blowout with air pressure, the hole in this case was very small, as illustrated in Fig. 3.

Following the completion of the test welds, the manifold was placed in a vise and the welds tested to destruction by striking the nipples with a heavy hammer. In every case failure occurred in the parent metal of the nipple or in the

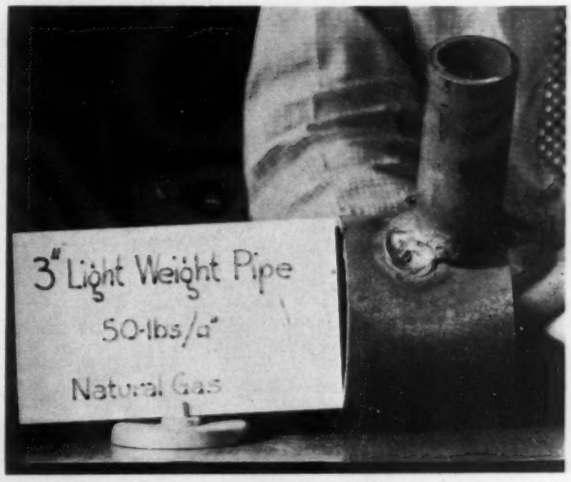


FIG. 3.

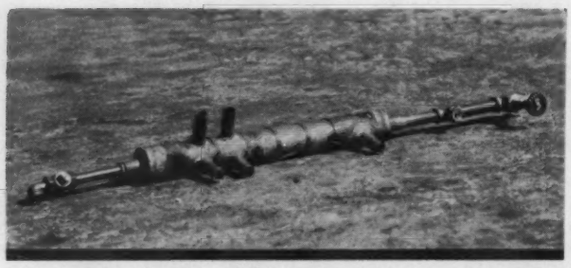


FIG. 4.

FIG. 5. Manifold of pipe corroded by soil.

weld itself but in no case did the weld pull away from the pipe. It may be concluded therefore that adequate penetration and proper fusion were obtained.

Considering the success met with in welding on 3-in. light weight pipe it was deemed meaningless to repeat the tests on pipes of greater wall thickness. However one sample weld was made on 4-in. standard pipe at 50 lbs. per sq. in. in order to test the influence of increased welding time on the penetration of carburizing on the underside of the weld. No significant difference was observed.

Experiments on Thin Pipe Sections

Reducing the thickness of the pipe wall by machining down a 3-in. light weight pipe was next resorted to for three reasons: (1) pressures in excess of about 77 lbs. per. sq. in. were not conveniently available (2) reasonable prudence dictated that higher pressures should be avoided if possible, and (3) in field practice the pipe to be welded on is not always new, but may have varying amounts of metal removed by soil corrosion. Accordingly, a manifold was constructed as shown in Fig. 4. As shown, adjacent rings were turned down on a lathe to the following specifications:

1. 0.000 in. metal removed, 0.148 in. metal remaining
2. 0.031 in. metal removed, 0.117 in. metal remaining
3. 0.060 in. metal removed, 0.088 in. metal remaining
4. 0.083 in. metal removed, 0.065 in. metal remaining
5. 0.091 in. metal removed, 0.057 in. metal remaining
6. 0.119 in. metal removed, 0.029 in. metal remaining

This manifold was then placed under a pressure of 50 lbs. per sq. in. of natural gas. A control nipple was first welded on the section of the manifold which had not been reduced in thickness (tip No. 5, oxygen and acetylene six lb.) Next, an attempt was made to weld on a nipple to the section having a wall thickness of 0.117 in. Approximately three-quarters of the weld was complete before failure occurred. The blow-out occurred where the nipple had been at first tacked to the manifold. It seems obvious that the initial heating of this particular spot caused a sufficient penetration of carbon on the inside, with a consequent loss of strength, to cause failure as the weld passed over the spot. It is possible that if the nipple had not been tacked, and the weld made in one continuous operation, that it would have been successful. In order, however, to test whether or not 50 lbs. per sq. in. is the critical pressure for this thickness, the manifold pressure was dropped to 30 lbs. per sq. in., and another attempt was made. This time there was no difficulty. An attempt was next made to weld a nipple on the section having a wall thickness of 0.088 in. at 50 lbs. per sq. in. In this case the welder had scarcely commenced to deposit metal before failure occurred. The pressure was then reduced to 30 lbs. per sq. in. and another attempt made. As before, failure occurred soon after welding was begun.

Because of the common belief that the electric arc, with its more localized zone of heating, is a safer method of welding under these conditions, an attempt was made to make an electric arc weld on the section last described (wall thickness 0.117 in.) However, the electric arc proved no more effective than the gas torch, failure occurring almost at once. While no conclusions are warranted from this single experiment, yet it is the author's opinion that the electric arc is less flexible than the gas torch, from the standpoint of penetration. This aspect might well be explored with greater thoroughness.

Welding on Naturally Corroded Pipe

It must, of course, be appreciated that welding on new pipe is somewhat different from welding on corroded, rusty pipe. For the purpose of observing the effect of rust and corrosion products on welding technique, a manifold was constructed of 3 in. standard pipe salvaged from the junk pile. A description of the corrosion on this specimen is as follows:

Deepest pit—0.054 in.

Average of deepest pits on equal areas—0.0295 in.

Average of 150 of deepest pits selected at random—0.0185 in.

It will be seen, therefore, that only moderate pitting was present. Under a pressure of 50 lbs. per sq. in., two nipples were welded on by two different welders using the gas torch. A nipple was then welded on by means of the electric arc. In all cases the nipple was placed on the top of the manifold strictly without reference to the presence of corrosion pits. With the exception of a noticeable increase in the time required to complete a weld, nothing of significance was noted.

It was not specifically intended in the foregoing test to ascertain the effect of the pits upon the maximum permissible welding pressure. For this purpose, another manifold was constructed, consisting of short lengths of very badly corroded 4-, 3- and 2-in. standard pipe. This manifold may be seen in Fig. 5.

A description of the corrosion on the various pipes comprising this manifold is impossible since, in all cases, the spot chosen to weld on the nipple was so badly corroded that the original surface of the pipe was gone.

Both the gas torch and the electric arc were used in welding, the pressure was varied between 25 and 40 lbs. per sq. in., nipples were welded to the sides as well as the top, and in one case, where the seam was plainly visible, a nipple was welded on a-straddle it. In no case did the welding puddle penetrate the pipe and cause failure. Neither were any difficulties encountered nor any abnormal behaviorism observed. Two incidental observations may, however, be of interest.

While welding on the 3-in. standard pipe, on an especially thin spot, chosen for that reason, a failure occurred in the wall of the pipe about one inch away from the welding puddle. This may be seen in Fig. 6 on the right hand side of the nipple, and has a small fan-shaped discoloration emanating from it. Afterwards it was found that the thickness of the pipe at this joint was about that of an ordinary sheet of paper. While there can be no sure explanation for this failure, it is possible that contraction strains resulting from

FIG. 6.

the cooling of the first portion of the weld opened a lamination in the pipe wall.

When the weld on the 2-in. standard pipe section of the manifold was cut out, an interior nodule was found which is the largest the author has seen. Incidentally, this effect is made more marked in the case of the gas welds than the electric welds. Fig. 7 was a gas weld.

Differences in the Composition of Pipe Metal

According to the manufacturers' specifications, the tensile strength of seamless tubing metal is 15 to 20 thousand lbs. per sq. in. greater than standard butt and lab welded pipe metal. At the elevated temperatures of welding it is probable that this difference in strength is not significant.[3] In order to confirm this, however, a manifold of two-in. standard pipe was made. Two-in. standard pipe has a wall thickness of 0.154 in. as compared to 0.148 in. for the 3-in. light weight, or a difference of 0.006 in. The test welds failed to disclose any significant characteristics in the weld-ability of the two kinds of pipe. Fig. 8 indicates that the size of a blow-out hole is approximately the same as those previously encountered on "live" gas lines.

Experiments with Artificially Pitted Pipe

The experiments on the naturally corroded pipe were not altogether satisfactory, principally because the remaining thickness of the pipe wall in the path of the weld could not be conveniently determined. To remedy this difficulty, a manifold was constructed of 3-in. light weight pipe, new, into which pits of the required depth, and placed in the proper manner, were gouged (Fig. 9). The pits were so located that they fell in the center line of the weld. In this way the welder was required to pass over each of them as he made the weld. The following is a tabulation of the specifications of the pits:

	Average Depth	Remaining Wall Thickness
Group 1	0.037 in.	0.111 in.
Group 2	0.070 in.	0.078 in.
Group 3	0.087 in.	0.061 in.
Group 4	0.105 in.	0.043 in.

This manifold was subjected to a pressure of 50 lbs. per sq. in. of natural gas, and a series of nipples welded on as shown in Fig. 10. One nipple was first welded on the unaltered pipe as a control nipple. Afterwards, a nipple was welded in the center of each of the artificial pit groups. In all cases the welds were successful, and when tested to destruction it was found that fusion was satisfactory.

It may seem strange that pits may be welded over more successfully than a corresponding uniform reduction of the entire pipe's surface. This is explained, however, by the difference in technique. When a pit is encountered in the path of the weld, the welder flows his rod into the pit until it is flush with the pipe's surface, but does not fuse this metal to the bottom of the pit, and when the pit has been built up properly, the welder then bridges over the pit with additional metal, and fuses it to the unaltered pipe wall beyond the pit. By this practice the fillet is broadened, but its soundness is in no way altered.

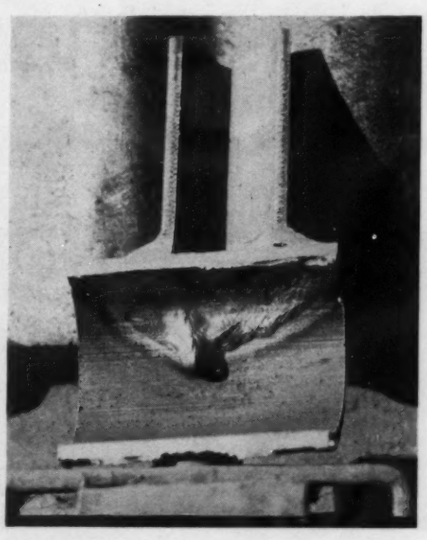


FIG. 7.

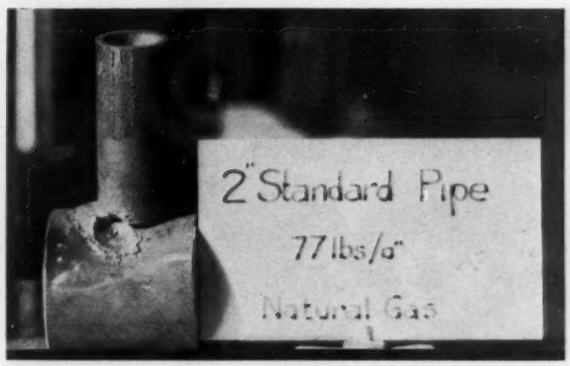


FIG. 8.

Experiments on the Ignitability of Escaping Gas

During the course of the foregoing experiments many blow-outs occurred, some of which could not be prevented, and some of which were deliberately created. In no case was it possible to ignite the escaping gas, so long as there was any appreciable pressure in the manifold. Referring particularly to Fig. 10, the third nipple from the left end is a case of a deliberate blow-out at 77 lbs. per sq. in. pressure. Following the blow-out, an attempt was made to ignite the escaping gas by gently waving the lighted welding torch in the path of the flowing gas, holding it at various distances away from the hole. The attempt was unsuccessful. The pressure was then reduced by stages and similar attempts made. Not until the pressure had been reduced below the readable limits of the gage was ignition obtained. In addition to the case just described, no less than a half dozen other blow-outs were similarly tested, always with the same result.

The difficulty of igniting the gas escaping from a weld blow-hole can be easily explained. By cutting out the nipple and holding it to the light, it was observed that the hole created was invariably smaller than a common sewing needle. Obviously, the gas escaping from such a small aperature under such high pressures travels with terrific velocity. Since the flame speed of natural gas is less than 30 ft. per second, it is an easy matter to calculate the pressure at which this velocity is obtained. (See Appendix)

It would seem, therefore, that so long as the escaping gas has an uninterrupted path to diffuse into the air, high internal gas pressure will prohibit the ignition of the escaping gas. It is obvious, however, that under practical field conditions a welder is often called upon to make welds under conditions where, should a blow-out occur, the gas would not have a free path. For the purpose of discovering the seriousness of obstructions in the path of the escaping gas, the following experiments were conducted.

A nipple was partially welded to a short manifold of 3-in. light weight pipe and a blow-hold deliberately created. Extra pains were taken to assure that this hole would be as large as possible. A trench was then dug, having the approximate dimensions, 3 x 1½ x 3 ft. Into this trench was lowered the manifold, and placed in the approximate position of a normal pipe with respect to the bottom and sides of the trench. After allowing the gas to blow for a reasonable time, a lighted welding torch was lowered into the excavation. The manifold was then turned on its axis through 360 degrees. In no position did ignition take place with pressures varying from about one-half lb. per sq. in. to 25 lbs. per. sq. in. The manifold was then moved closer to the wall and also to the bottom of the trench, the pressure being varied as before. It was finally determined that approximately four in. from the wall or bottom of the ditch was the critical distance. In several instances a sustained flame was obtained at this distance with the various pressures used. Approximately the same tests were made in the shop using a baffle plate, but due possibly to drafts, the gas was more difficult to light. From these tests it would appear that under any condition where the welder has sufficient room to manipulate his torch, sustained ignition is most unlikely.

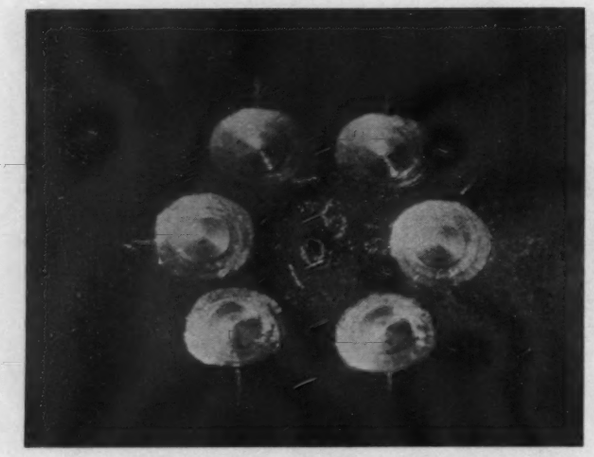


FIG. 9.

Conclusions

1. The skill and technique of the welder are the most important factors in making welds on live gas lines.
2. The presence of moderate pitting in the pipe wall due to soil corrosion is of little significance, provided the proper welding technique is employed.
3. Failure of the pipe wall during welding does not ordinarily constitute a serious hazard.
4. Under normal conditions in gas distribution practice, where pressures do not usually exceed 50 lbs. per sq. in., oxy-acetylene welding may be successfully and safely done on all live lines except where soil corrosion has uniformly reduced the pipe's wall thickness below about 0.073 in., or where there is danger that a seam or lamination in the pipe may be opened.

APPENDIX

Mathematical Analysis of Pipe Wall Stress

It is extremely difficult if not impossible, to calculate with precision the maximum internal pressure under which it is safe to weld; because of the necessity of making certain broad assumptions, and because of the uncertainty with which some of the important factors must be evaluated.

The following, however, is suggested as a fundamentally sound approach to a practical mathematical solution:

That steel loses strength very rapidly when heated to temperatures bordering upon the melting point is a well known fact. Peculiarly, however, the heating of steel from atmospheric temperature to about 600° F. does not weaken it; as a matter of fact, the exact contrary, the maximum strength of most steels being at about this temperature. It seems obvious, therefore, that when a fillet weld, such as a service connection, is made on the outside of a pipe, there is a certain zone, or area, in the pipe's wall adjacent to the weld which is weakened in the process. The magnitude of this weakened zone is dependent upon a number of factors, but for any given set of conditions its extent can be roughly approximated. Referring to Fig. 11, it will be observed that for a typical case the temperatures in the wall of the pipe grade from about 2730° F., at the bottom of the welding puddle, to 600° F. at some distance (r) from the bottom of the puddle.

Suppose it be assumed that there is a sharp line of demarkation at the outer rim of the radius (r) on one side of which the temperature is 600° F., and on the other side, or the side toward the weld, the temperature is (t) degrees F. While this condition is not actually true, yet by a proper empirical evaluation of (r) and (t) a true condition could be approximated.

As long as the value of (t) is large, compared with 600° F., we may visualize a roughly circular area in the pipe wall, with a radius (r) which resembles a diaphragm solidly fixed at its periphery. It may be so considered by reason of the considerable difference in temperature existing at the supposed border-line, with the consequent great difference in mechanical strength of the metal under the two temperature conditions.

Many able investigators have analyzed, both mathematically and experimentally, the nature and magnitude of the stresses occurring in plates or diaphragms rigidly fixed at their edges and subjected to pressure on one side. Researches of considerable importance in this connection have been made by Steinthal[5] and Carrington[6]. The latter cites the following equation as applying to problems of this character:

$$\frac{ET^3\Delta}{12(1-\delta^2)} = \tfrac{1}{64}\,Wr_1^4 + \tfrac{1}{4}\,Br_1^2 + D \qquad (1)$$

in which,

E equals Young's Modulus of tensile elasticity
T equals Thickness of the plate in inches
Δ equals deflection at radius r_1, in inches
W equals pressure in pounds per square inch, gage
r_1 equals radius of the plate in inches
δ equals Poisson's ratio of lateral to longitudinal deformation
B and D equal constants.

Utilizing this equation Grashof[7] (also Fuller and Johnston[8]) has shown that when the constants are evaluated for the conditions

$$\Delta = \frac{d\Delta}{dr} = o\,,\ \text{at}\ r = r_1$$

where (r) equals the radius of the plate, that the following simplification can be made:

$$\Delta = \tfrac{3}{16}\,\frac{\left(\frac{1}{\delta}\right)^2 - 1}{\left(\frac{1}{\delta}\right)^2}\,\frac{Wr}{ET^3} \qquad (2)$$

Now, it may be easily shown that

$$\Delta = \frac{L^2S}{32EY} \qquad (3)$$

where,

L equals length of the beam in in.
S equals maximum fiber stress in lbs. per sq. in.
Y equals distance from the neutral axis to most distant fiber in in.

Furthermore, in (3)

$$L^2 = 4r^2$$

and,

$$Y = \frac{T}{2}$$

therefore, by substitution, using a value of Poisson's ratio equal to 0.2686[9]

$$\frac{4r^2S}{16ET} = \tfrac{3}{16}\,\frac{3.723^2 - 1}{3.723^2}\,\frac{Wr^4}{ET^3} \qquad (4)$$

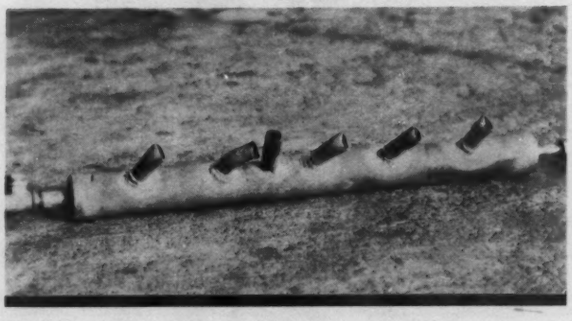


FIG. 10.

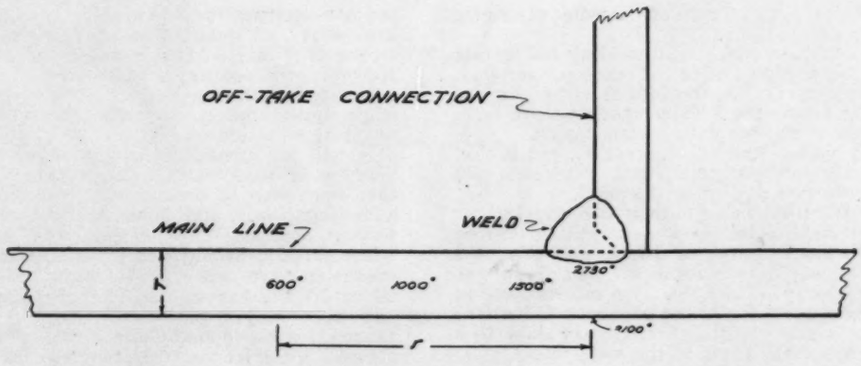


FIG. 11.

whence, finally

$$S = \frac{154.32\ Wr^2}{221.76\ T^2} \qquad (5)$$

Equation (5), however, is not entirely suitable for the purpose at hand in view of the fact that it represents conditions in a flat plate while the wall of the pipe has a certain amount of curvature. Morley[10] and Boyd[11] have shown that the ratio of the stresses in a curved beam as compared with a straight beam, when the curvature is of the same order as that in the wall of a circular pipe, is approximately 0.7. Therefore, equation (5) becomes

$$W = \frac{2ST^2}{r^2} \qquad (6)$$

Equation (6), while it appears to be of simple form, algebraically, is in reality difficult to apply, because of the very real difficulties of evaluating the variables.

Ignitability of Escaping Gas

The velocity of a fluid escaping from an orifice in the wall of a reservoir may be calculated from the equation

$$V = C\sqrt{2gh}\ .$$

Assuming that the orifice coefficient is 0.8, (g) is equal to 32.17 and the specific gravity of the gas is 0.65, it can be calculated that in order to obtain a velocity of efflux equal to the flame speed of natural gas, or 30 ft. per second, the pressure within the vessel must be equal to 22 ft. head of the fluid. This is equivalent to 0.0076 lbs. per sq. in., or 0.21 in. water column.

An informal experiment produced the following data:

Size of Orifice (Standard Drill)	Maximum Internal Pressure for Sustained Ignition (Inches Water Column)
76	0.75 in.
68	1.00 in.
53	2.00 in.
43	4.00 in.
30	10.00 in.

LITERATURE CITED

1. *Repairs to High Pressure Transmission Lines Without Service Interruption* by F. E. Wilson, Pacific Gas and Electric Co. Paper presented before Pacific Coast Gas Association in December, 1937.
2. *Metallurgical Study of Welds* by N. K. Senatoroff, Southern Counties Gas Co., of California.
3. *Mechanical Engineer's Handbook* by L. S. Marks. Mc-Graw-Hill, 1930, page 583.
4. *An Introduction to Pareto* by Homans and Curtis. A. A. Knopf, 1934.
5. Steinthal. Engineering, Volume 91, page 677, 1911.
6. *The Deflection of Flat Plates Fixed at the Circumference* by H. Carrington. Engineering. Volume 125, page 31, 1928.
7. Grashof. Festigkeitslehre.
8. *Applied Mechanics, Volume II, Strength of Materials* by Fuller and Johnston. John Wiley and Sons, 1919.
9. *Johnson's Materials of Construction.* John Wiley and Sons, 1925, page 4.
10. *Strength of Materials* by Morley.
11. *Strength of Materials* by Boyd.

The Metallurgical Study of Welds

By N. K. SENATOROFF

*Southern California Gas Company**

IN THE past decade, natural gas has completely displaced the manufactured product as a fuel for domestic and industrial purposes in many districts of Southern California. Its advent presented new problems to the engineers in transmission, distribution, and utilization fields, the solution of which requires greater safety, higher quality, and longer probable life of their equipment. Among the number of new problems, those of weld design and fabrication are occupying a unique field. Their importance has now become very great. There have been many failures in the past traceable to improper welding technique, which were too costly to be neglected, and as a result they exerted considerable influence upon the development of entirely new welding methods or the improvements in old ones.

As in almost any other field of development, welding practices received their greatest encouragement from the practical men. In recent years, however, the complexity and quality of standards made it necessary to seek the assistance of scientists of all kinds in order to determine what methods or what changes in old existing methods would make the best welds, taking into consideration the three essentials of security, service, and cost.

A frequent specification for a welded joint is that it should be as good as possible and as cheap as possible. Fundamentally, the requirement is that the weld shall be just good enough to meet the service requirements. Any money expended to meet requirements in excess of the actual service is money wasted. It would be quite uneconomical to use the quality welds which, for instance, have been satisfactory for the building of high pressure oil cracking vessels in welding service connections on low pressure gas distribution mains.

All this leads to the inevitable question of weld testing practices and most commonly used methods.

Weld Tests

The question of testing welds is one that has been considered constantly since the discovery of the art of welding. While some of the test methods employed at present are beyond the reach of the ordinary welding shop, yet they are of great value and are necessary in order to determine correctly what has occurred during the welding operation and what results may be expected under given conditions. Today the testing procedure is quite well developed both in theory and practice. It includes the determination of:

* A Report of the Construction and Maintenance Subcommittee, Distribution Committee, Technical Section, Pacific Coast Gas Association.

1. Physical properties in terms of tensile strength, ductility, fatigue, impact load, etc.
2. Chemical analysis of both parent and welding rod metals comprising the per cent composition of carbon, sulphur, silicon, and other elements that enter into it either as impurities or as alloying substances. Many specifications have been written which consider these data indispensable.
3. Metallurgical study in terms of penetration, grain size, cracks, inclusions, and many other special characteristics that may influence the serviceability in the weld.

While no single determination of either the physical or chemical properties of weld metal reveals everything desired to be known, metallurgical study furnishes, probably, the most varied and complete information in regard to the soundness and serviceability of a weld. The information so obtained may serve as a basis for either separate deductions and conclusions or it may be used as preliminary data to a chemical or mechanical examination of the weld metal.

Classification of Methods

There are two general methods of testing for the quality of welds, namely non-destructive and destructive. The destructive methods are exemplified by bend, tensile strength, impact, fatigue, and metallographic tests. The non-destructive methods include visual examination, electrical resistance, stethoscopic, hammer, pressure, and X-ray tests. Destructive methods may be quantitative as well as qualitative, while the non-destructive methods, in the present state of the art, are nearly all qualitative, that is they do not include how strong the weld is, but whether or not defects are present. However, the results of non-destructive tests, when properly correlated with the results of destructive tests of welds, made under similar conditions, may be an indication of the physical condition of the welds.

It will be impossible in this paper to consider all known methods of weld testing, and for this reason we will confine this discussion to details of the metallographic method, its advantages only, and demonstrate its practical value in weld testing practice. This method was selected by the author when given a problem of investigation of the quality welds made on live gas mains with pressures varying from 26 to 50 lbs. per sq. in. The gas mains included standard and light weight pipe of 2-, 3-, and 4-in. sizes. The weld fabrication was done by either the oxy-acetylene process with Oxweld No. 1 Hi-test rod or by electric arc with "Fleetweld" No. 5 and No. 7 electrodes.

However, before we proceed, it may be well to mention in a few words the X-ray method of testing welds and point out the chief factors that prevented its use in the investigations. The X-ray method has found wide industrial use and is recognized as the foremost non-destructive test for internal defects in a metal, such as cracks, slag, blowholes, lack of fusion, etc. but it was not considered here primarily for the economic reasons. Not only the high first cost of the equipment, but the excessive maintenance cost in the form of

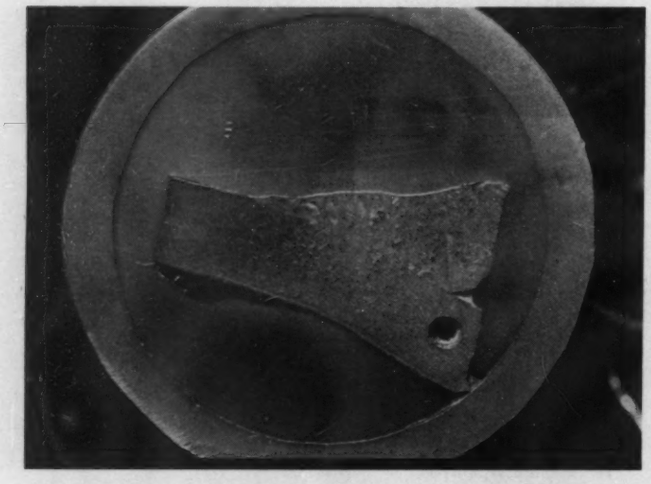


FIG. 1. Oxy-Acetylene — appearance of weld. New 4-in. standard weight pipe welded at 50 lbs. gas line pressure. Magnified 3.5 times. A view of the same weld magnified 11 times is shown in Fig. 2.

FIG. 2. Oxy-Acetylene — appearance of weld. New 4-in standard weight pipe welded at 50 lbs. gas line pressure. magnified 11 times. Note: 0.01 in. penetration, good fusion. Coarse crystalline structure of weld metal.

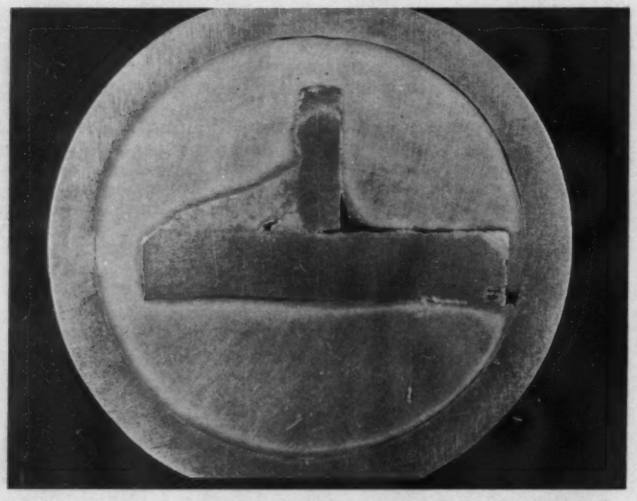


FIG. 3. Oxy-Acetylene—appearance of weld. Old, corroded 4-in. standard weight pipe welded at 26 lbs. gas line pressure. Magnified 3.5 times. A view of the same weld magnified 11 times is shown in Fig. 4.

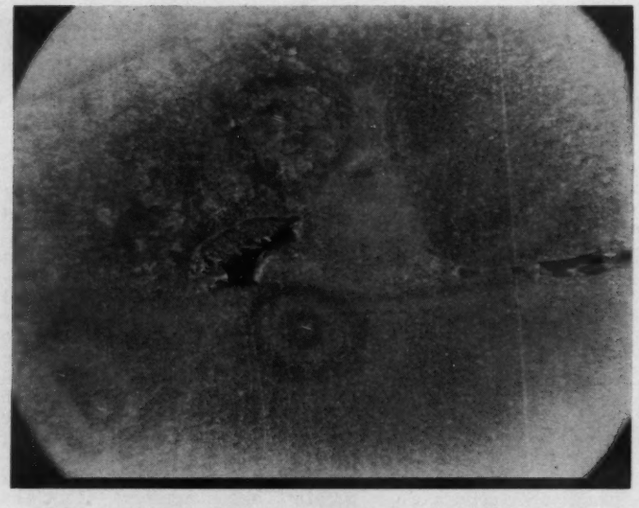


FIG. 4. Oxy-Acetylene—appearance of weld. Old, corroded 4-in. standard weight pipe welded at 26 lbs. gas line pressure. Magnified 11 times. Note: 0.02 in. penetration, good fusion. Presence of gas pocket which may cause service failure.

AT LEFT

FIG. 5. Oxy-Acetylene—appearance of weld. New 3-in. light weight pipe welded at 50 lbs. gas line pressure. Magnified 3.5 times. Views of the same weld under different degrees of magnification are shown in FIGS. 6 and 7.

AT RIGHT

FIG. 7. Oxy-Acetylene—appearance of weld. New 3-in. light weight pipe welded at 50 lbs. gas line pressure. Magnified 100 times. Note: Slag inclusions on the line of fusion. Coarse dendritic structure of weld metal (top). Coarse crystalline structure of pipe metal adjacent to weld (bottom).

employment of highly skilled operators, made it prohibitive for use in a small laboratory of an average size gas company or in a welding shop.

Metallographic Method

This method is based on the examination of the crystalline structure of the metal either visually or with the aid of the microscope, and is considered best among the tests of welds included in destructive type methods. Its principal function is to determine the extent and location of impurities, inclusions, cracks, etc. but in addition to these characteristics it enables one to study the effects of various heat treatments on the crystalline structure of both parent and weld metal. In the study of welds this information is particularly valuable because of the nature of the weld metal. As a casting, a weld is subject to all the defects found in the casting, but to a greater degree. Consequently data on the physical properties and chemical composition of the weld metal are not sufficient to portray, for instance, the true picture of the quality of heat treatment that had been involved in its fabrication.

In order to show up the crystalline structure, sections of welds are cut out and ground or filed to obtain a flat surface. An emery or carborundum wheel found in any size of shop is all the grinding equipment that is required. Subsequent polishing on emery papers is done by hand. The polishing operation should not take more than half an hour to go through four grades of French emery paper, in order to obtain a fairly smooth surface for etching. The etching operation with an etching reagent, like 4 per cent nithol solution, requires varying periods of time, from a few seconds to several minutes, in order to bring out the macrostructure of the metal. The etching reagent eats away the defects and makes the edges of the sound material stand out, so that larger grooves and pits will be visible, where the defects prior to the etching would pass unnoticed. Important or interesting samples of weld could be photographed with or without magnification or could be filed, as such, for future reference. Higher magnifications of course require the use of a microscope, but ordinary weld examinations are made either visually or with the aid of a common magnifying glass.

The entire procedure from the preparation of the weld cut out to the final examination of its structure could be made by any employee who was familiar with the general requirements of laboratory technique and should not take more than one hour for each weld.

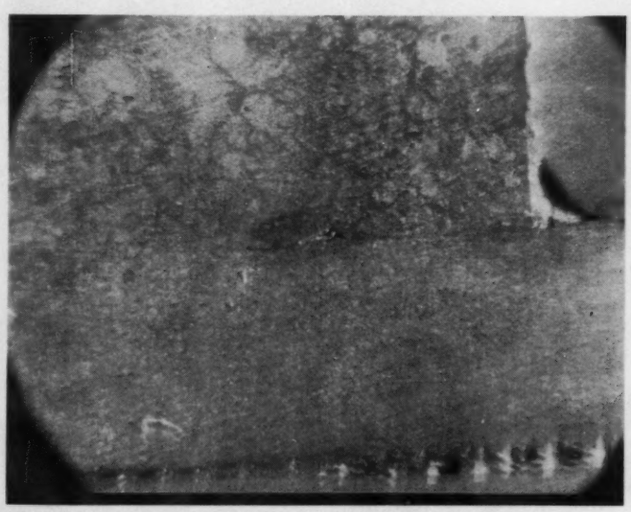


FIG. 6. Oxy-Acetylene—appearance of weld. New 3-in. light weight pipe welded at 50 lbs. gas line pressure. Magnified 11 times. Note: Deep penetration approximately 0.05 in. Poor fusion at the foot of nipple. Slag inclusions and coarse crystalline structure of weld metal near the foot of the nipple.

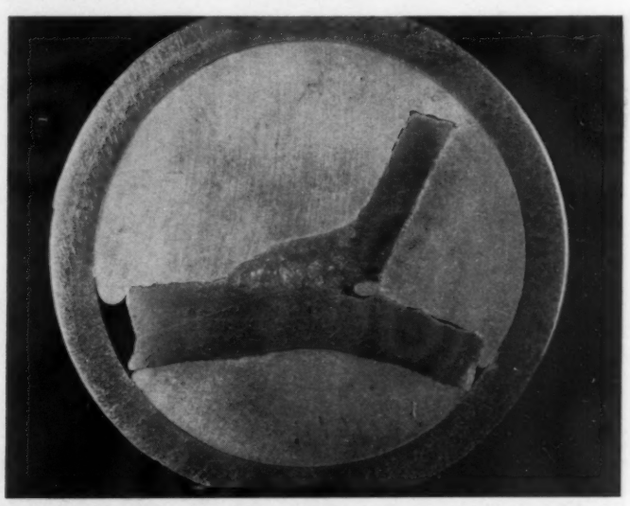


FIG. 8. Oxy-Acetylene — appearance of weld. Old, badly pitted, 3-in. standard weight pipe welded at 26 lbs. gas line pressure. Above photograph shows weld magnified 3.5 times. A view of this same weld magnified 11 times is shown as FIG. 9 on the following page.

Practical Application

A great deal may be learned from the appearance of the weld. It is difficult to describe in words the appearance of good welds, but after they have been shown on the photographs and seen by the welders and weld inspectors, their structure will tell whether the operator knows what he is doing.

Sample pipe welding specifications of the International Acetylene Association require that all welding shall be done by competent welding equipment operators and in a thorough, first class, workmanlike manner. In order to comply with these requirements consistently, weld manufacturers are forced to adopt some method of checking up, periodically, the quality workmanship of their welders and maintain a continuous record of their standards. Macrophotographs are well suited for this purpose and if properly catalogued will greatly simplify the procedure of recording individual performances. The welder's identification number on each weld fabricated by him will be the simplest way of tying in the responsibility for the serviceability and safety of the weld.

Macro and Microphotographic Illustrations of the Method

The samples of welds illustrated throughout this paper were taken from a series of experimental welds made on live gas mains. They are shown to portray the practical application of the metallurgical method of study in weld fabrication. Although the descriptions of the photographs are self-explanatory, we feel that an explanation of some of the terms would be appropriate in order to facilitate the examination of the pictures.

The crystalline structure or crystal grain structure of a metal is formed at the commencement of solidification when small crystals of varying orientation or center of crystallization develop in the still molten mass. The boundary lines of the individual crystals or groups of crystals are easily detected by the difference in reflecting power of light by the

FIG. 9. Oxy-Acetylene — appearance of weld. Old, 3-in. standard weight pipe welded at 26 lbs. gas line pressure. Magnified 11 times. Note: Penetration approximately 0.03 in. deep, good fusion. Very coarse crystalline structure of weld metal and poor fit of the nipple before welding.

FIG. 10. Oxy-Acetylene—appearance of weld. Old, badly pitted 2-in. standard weight pipe welded at 26 lbs. gas line pressure. Magnified 3.5 times.

FIG. 11. Oxy-Acetylene—same as FIG. 10. Old, badly pitted 2-in. standard weight pipe welded at 26 lbs. gas line pressure. Magnified 11 times. Note: Penetration approximately 0.05 in. deep, good fusion. Slag inclusions, very poor fit of the nipple and split in the fillet makes this weld unsatisfactory and unsafe.

FIG. 12. Oxy-Acetylene—same as FIG. 10. Old, pitted 2-in. standard weight pipe welded at 26 lbs. gas line pressure. Magnified 100 times. Cross section of the bead found on the inner surface of the pipe and seen on the extreme left end of the picture. Note: Carburization zone approximately 0.01 in. deep in the parent metal (upper) and dendritic crystalline structure of the bead.

plane faces of the crystals and enable us to compare the size or shape of the two adjacent surfaces. Uniformity and refinement in grain sizes constitute a good weld.

Dendritic structure is a tree-like crystalline structure developed during the solidification period when there is an external force that interferes with the normal crystalline growth of the metal. Excessive dendritic growth is an objectionable feature in a weld. Conversely, the absence of dendritic structure is indicative of a good weld.

Fusion, or blending, is a phenomenon that occurs in the art of welding when the pipe and welding rod metals mix together at the elevated temperature of the arc or the torch. It is indicated by the disappearance of the junction line between the pipe metal and the deposited rod material. The absence of a distinct boundary line at the contact surface of both materials is indicative of good fusion.

Penetration is determined by the depth of indentation of the fused metal into the pipe wall and is expressed quantitatively in inches of depth from the projected imaginary line of the contact surface of the pipe before welding. The depth of penetration varies from 0.15-in. to 0.03-in. for oxy-acetylene and from 0.03-in. to 0.06-in. for arc processes and if within these limits is considered a good penetration.

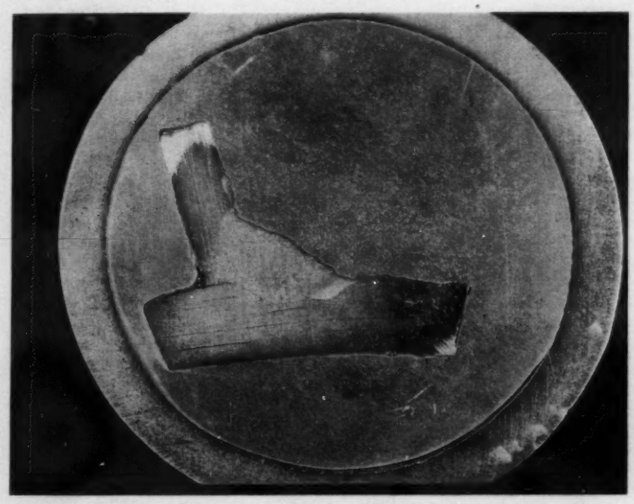


FIG. 13. Electric Arc—appearance of weld. Old, corroded 4-in. standard weight pipe welded at 40 lbs. gas line pressure. Magnified 3.5 times.

FIG. 14. Electric Arc—same as FIG. 13. Old, corroded 4-in. standard weight pipe welded at 40 lbs. gas line pressure. Magnified 11 times. Note: Penetration very deep, approximately 0.06 in. good fusion. Crystalline structure of weld metal is finer than oxy-acetylene method. Sharp dissimilarity of the fillet structure, indicating that part of weld was made in two beads.

FIG. 15. Electric Arc—same as FIG. 13. Old, corroded 4-in. standard weight pipe welded at 40 lbs. gas line pressure. Magnified 100 times. Note: Very good fusion. Fine crystalline structure of weld metal (top) and coarse structure of pipe metal (bottom), also presence of gas holes and slag inclusions.

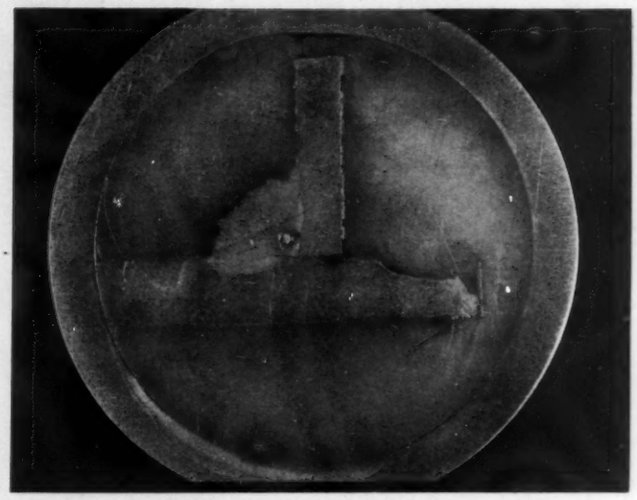


FIG. 16. Electric Arc—appearance of weld. Old, pitted 3 in. standard weight pipe welded at 40 lbs. gas line pressure. Magnified 3.5 times.

Common Defects of Welds

Defects in welds occur in such a manner and from such causes as to make it impossible to predict either their location or their extent. This fact alone would make the behavior of a defective weld unpredictable. In as much as it is believed that the serious defects in welds are caused by oxides it would appear essential in the case of gas welding to use no larger flame tip than is necessary to produce thorough fusion. The reason is that at the high temperatures of the steel, caused by too large a tip, the metal becomes over-heated and in that condition combines more readily with the oxygen of the air or with any excess oxygen in the torch flame and produces oxides which are readily dissolved in the molten metal. Upon cooling down, the oxides are rejected and pass to the grain boundaries as an inclusion. Figs. 5, 6, 7, 10, 11, 15, 16 and 17 illustrate this point. Among other most common defects in welds are lack of penetration,

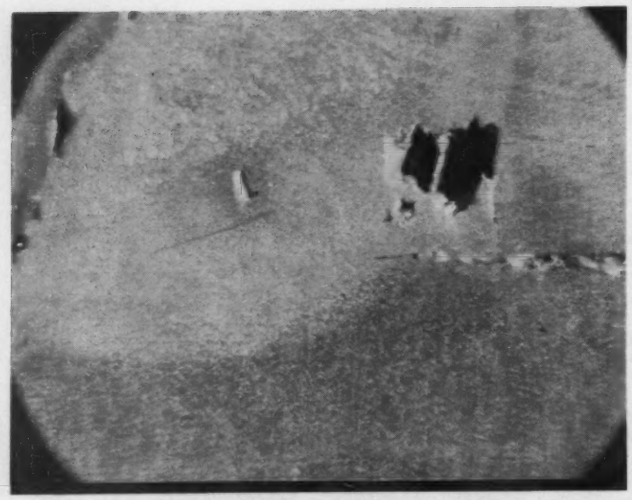


FIG. 17. Electric Arc—same as FIG. 16. Old, pitted 3-in. standard weight pipe welded at 40 lbs. gas line pressure. Magnified 11 times. Note: Penetration very deep, approximately 0.08 in., into pipe metal, but lack of fusion near the foot of the nipple. Large slag pocket and ununiform crystalline structure of the fillet. Weld was made in two beads.

poor fusion (Fig. 17), burning of the metal, and gas and slag pockets (Figs. 3, 4, 16, 17).

Excessive temperatures of steels in contact with the carburizing properties of natural gas are likewise responsible for the frequently encountered phenomenon of case hardening on the inner surface of the pipe along the path of the welding torch. The affinity of iron for carbon is so great that when heated to a temperature above 1500° F. in contact with suitable material it readily absorbs that element. An extensive series of experiments dealing with the case hardening of iron with various gases under varying conditions of temperature, time, flow of gas, and pressure, conducted by Dr. F. C. Langenburg (See reference (1) below), clearly demonstrated that the rate of carbon absorption was the greatest when the gas pressure rose from 0 to some 40 lbs. per sq. in., other factors being equal.

To get some idea on the rate of carbon penetration the reader is referred to Fig. 12. During the normal time required to weld a nipple to the old 2-in. standard weight pipe the carburization zone extended to the depth of 0.01 in. into the wall of the pipe. The amount of absorbed carbon was sufficient to lower the melting point of the heated steel, so that it was in a molten state, sufficiently fluid to form a bead or a droplet on the inner surface of the pipe. Subsequent solidification of the droplet resulted in the dendritic structure quite different from the original crystalline structure of the pipe material.

All welds shown in the photographs and photomicrographs and discussed in this paper were made in the shop, under the most favorable working conditions, and in spite of that they all exhibit one or more of the common types of defects. Welds made in the field by the average operator would probably be even less satisfactory from the metallurgical point of view and would constitute potential future service hazards, especially if they are made on high pressure, old, corroded and pitted mains.

Summary

A method of weld testing has been developed in welding practice investigation which will aid weld manufacturers to raise the standards of workmanship in weld fabrication. It is believed that this method could be economically adopted for training classes of welders in an average size industrial shop. It is not forgotten that welds of inferior quality, in some cases, may answer the purpose satisfactorily; nevertheless, if their quality could be improved without the introduction of expensive equipment for their testing, it seems quite logical to make the improvement.

LITERATURE CITED

(1) Sauveur—*The Metallography and Heat Treatment of Iron and Steel*, Ch. 18, "Cementation and Case Hardening of Steel," p. 299

(2) Gillet—*Introduction to the Study of Metallography and Macrography.*

Notes on the Maintenance of Combustible Gas Indicators

By F. R. BATER

*San Diego Consolidated Gas and Electric Company**

THE usefulness of combustible gas indicators to the gas industry is too well established to warrant more than passing comment. The San Diego Consolidated Gas and Electric Co. recognized the utility of these devices several years ago, and at the present time owns 18 instruments. Inasmuch as all of these instruments are in use every working day, a regular and systematic maintenance procedure is required to assure continuously satisfactory performance.

The maintenance notes set forth in this paper apply particularly to J-W Combustible Gas Indicators. The circuit diagram (Fig. 1) suggests the operating principle of this indicator. However, if a detailed explanation of the principle of operation is desired, it may be found in a paper by M. T. Burton, "Combustible Gas Detectors," P.C.G.A. 1936 Proceedings, (Vol. 27, p. 96).

As ordinarily used by gas companies, combustible gas indicators are called upon to perform two types of service. In one type of service, such as incidental and routine tests for locating gas leaks, the question of safety (relative to explosive mixtures) is of secondary importance. For this work, only relative readings of the instrument are of value and, therefore, precise calibration of the indicator is not necessary. The second type of service includes testing of manholes, valve pits, checking purging operations, etc., for the purpose of determining safe working conditions. It would seem, at first thought, that instruments used for this class of work, should be precisely calibrated. However, the meter scale of a combustible gas indicator is marked to show "dangerous" at a reading of 0.2; since a reading of 1.0 is required to indicate a mixture that is explosive, it is apparent that the "dangerous" mark allows a safety factor of five. Hence, an instrument which is considerably in error on the low side may be used without hazard.

In spite of the foregoing considerations, experience has shown that it is desirable, from the standpoint of uniformity and dependability, to maintain combustible gas indicators in such condition that registration is not more than 0.1 low. Experience has shown also that, to be reasonably certain of this degree of accuracy, frequent servicing and checking is essential. The San Diego Consolidated Gas and Electric Co. endeavors to test each instrument at least once a week, regardless of whether it is used or not. Instruments that receive considerable use are tested each day. Also, tests for approximately correct registration follow battery changes, filament unit changes, or any repairs to the electrical or piping system.

* A report of the Sub-committee on Construction and Maintenance, Distribution Committee, Technical Section, Pacific Coast Gas Association.

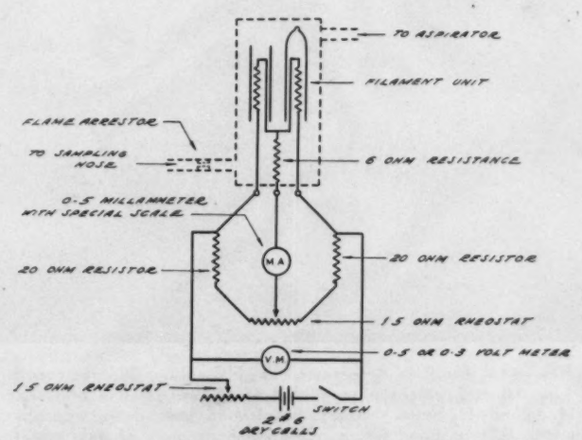


FIG. 1. Circuit diagram of J-W Combustible Gas Indicator.

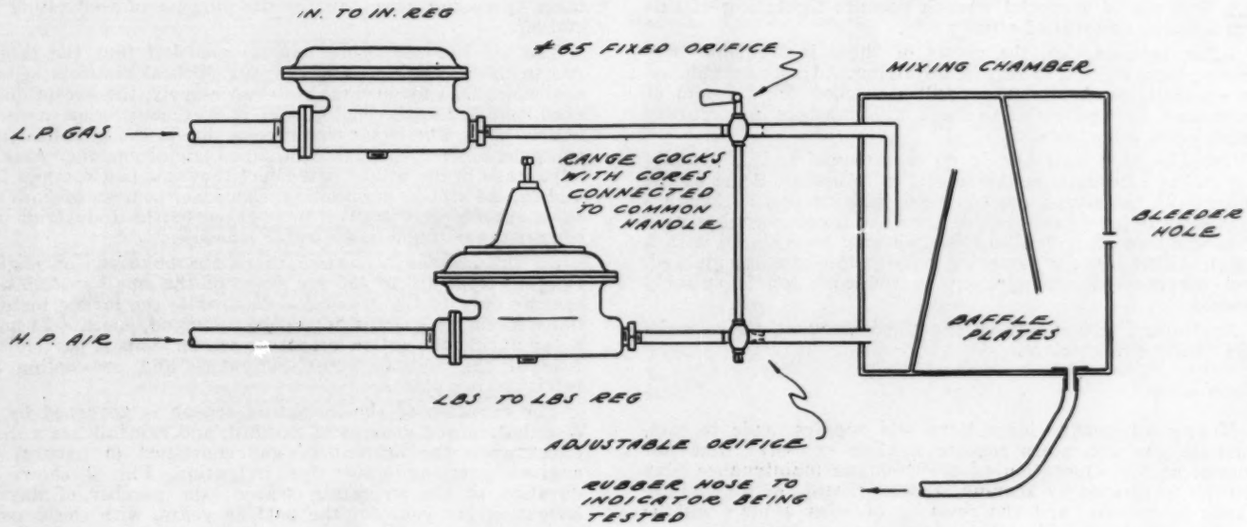


FIG. 2. Combustible gas indicator testing device.

Accuracy Tests

For routine accuracy tests, it is convenient and sufficient to check the indicators at only one point. The required gas-air mixture may be produced by various methods, but the method shown in Figs. 2 and 3 has proved to be as satisfactory as it is simple. The air-gas ratio is established by adjusting orifices and pressures until a reading of about 0.5 is indicated by several instruments that are in good condition. All adjustments should be made mechanically secure. A final check on the amount of gas in the mixture may be made by metering, separately, the air and gas supplied, or by analysis of the mixture. The per cent of explosibility may then be computed by using the lower explosibility limit of the gas as taken from published values, or as determined by experiment. Changes in specific gravity of the gas, pressure variations, and changes in gas analysis, produce variations in the value of this mixture, but in practice these variations seem to be well within the limits demanded of approximate checking.

Where greater accuracy is desired, gas (of known lower explosibility limit) and air may be measured separately into a gasometer and the resulting mixture used for a test sample.

Filament Units

Prior to 1935, considerable difficulty was experienced with regard to instability and erratic behavior of the J-W Combustible Gas Indicator. At that time, this trouble was attributed to filament units. Very often, indicators would be sent from the shop with new filaments only to be returned the next day with the millammeter needle jumping all over the scale. Eventually, it was found that this trouble was not due to filament units but due, instead, to poor contact of cap connectors with their companion base pins. Frequent cleaning of cap springs and base pins helped some, but complete elimination of this trouble was not secured until these instruments were "wired solid." The filament unit cap connectors were discarded and the wires soldered directly to the base pins, enough slack being allowed to permit removal of the unit from the gas chamber. The battery connector caps and pin blocks were discarded and the wires extended to allow direct connection to the batteries.

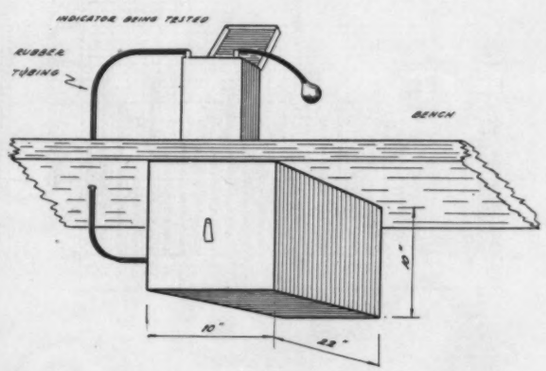


FIG. 3. Combustible gas indicator testing device mounted beneath the bench.

Trouble from poor contact at rheostats has been controlled by tight adjustment of slide arm tension and occasional cleaning of windings with fine sandpaper.

Filament units that receive considerable use gradually reach a condition where they produce low readings, or become so unbalanced that the indicator cannot be set to zero. Inspection of filament units that are out of balance usually reveals that one or more turns of the platinum filament coils have become short-circuited.

Maintenance records over the past two years show that average filament life is slightly greater than six months.

Batteries should be changed when the maximum volt meter reading obtainable is 0.1 to 0.2 volts above the operating voltage of the instrument. The volt meter needle should be observed for 15 to 20 seconds to see if the voltage drops rapidly. Rapid drop from the adjusted value indicates that the batteries are close to the end of their useful life.

Although serious trouble from dust can be avoided by using a dust filter, it is advisable to blow high pressure air through the piping periodically.

In wet weather, careless operation of these indicators sometimes results in water passing the filter and entering the piping and gas chamber. This often causes the indicator to respond erratically and may, if dust is present, partially or completely stop the piping. Such stoppages can usually be cleared with high pressure air but in some cases, it may be necessary to remove the piping from the instrument.

Leaks

Leaks in combustible gas indicators are not a common source of trouble. When they do develop, it will often be found that the cork gasket of the filament unit is the cause. These gaskets compress and lose their elasticity with age. Filament units screws should be tightened from time to time to compensate for this compression.

Sometimes a leak in J-W indicators is caused by the sampling valve becoming loose and twisting the piping. The lock nut that holds this valve to the case is so placed that it cannot be tightened with conventional wrenches unless the balancing rheostat and millammeter are removed. Construc-

tion and use of a special wrench permits tightening of this nut without removal of other parts.

After long service, the pivots of these instruments may become loose enough to require adjusting. Adjustments should be carefully made and the needles checked for freedom of movement. It is advisable to check millammeters for accuracy after pivot adjustments.

Trouble with switches is quite common and is usually deteetable by erratic behavior of the voltmeter. Some of the older J-W indicators are equipped with "pull-up" switches that seem to give more trouble than the toggle switches used in newer models. A "pull-up" switch may be replaced with a toggle switch, if the mounting hole in the case is enlarged, and the shut-off arrangement in the case top is suitably altered.

Aspirator bulbs should be examined frequently for cracks and faulty check valves.

Conclusion

Nearly all routine inspections and repairs made to combustible gas indicators require neither excessive time nor special ability. Operation of a systematic maintenance plan will be facilitated by keeping written records of all maintenance operations, and the rewards of such a plan will be consistently dependable service from these instruments.

The Servicing of Gas Engines

By C. L. FERRY

*Southern Counties Gas Company**

BEFORE attempting to discuss the servicing of internal combustion engines using natural gas as a fuel, it might be well to first substantiate the fact that it is a good investment on the part of the utility.

In Southern California there is between 400,000 and 500,000 hp. in internal combustion engines using natural gas as a fuel, the greater part being employed in oil fields, pumping, and operating gas compressors; however, there is in excess of 90,000 hp. in a hundred and one different applications where power is required, such as operating power machinery in industrial plants, refrigerating, ice manufacture, generation of electric energy, and pumping water for domestic and agricultural uses. In Southern California a large percentage of the water required for irrigation is pumped from wells ranging in depth from 250 to 1,000 ft. and, in some sections the water levels are in excess of 450 ft. below the surface.

As the underground water supply is dependent upon the rainfall, it would be natural to assume that the more rain that falls per season, the greater the supply of the underground strata, which is correct, provided the greater portion of the precipitation is not lost in run-off. (See Fig. 1 showing variation in water levels, rainfall, and canyon run-off). Note that the 1910 water level was 125 ft. In 1913 and 1914 the water level dropped to 260 ft. The 1914 rainfall was far above the average, floods occurring simultaneously in many sections of Southern California. The loss by flood in Los Angeles county during that year was estimated to be $10,000,000.00. The run-off must have been excessively heavy, as the magnitude of the 1914 flood is generally considered second only to the floods of 1884 and 1889. (The accompanying chart records no run-off in 1914, for those compiling this chart kept no such record prior to 1917). The average rainfall for 1915, 1916, and 1917 was above normal, and evidently was well distributed over 5.5 months each year, the usual rainy season, and, as the water level came back to 135 ft. in the latter part of 1917, there evidently was no excessive run-off. The water level gradually lowered to 340 ft. in the latter part of 1921, due to light rainfall, although the run-off was slight. In 1920 and 1921 the rainfall was above average, and the run-off increased. In 1922 the rainfall was above average, but poorly distributed, causing excessive run-off, and, at the end of 1922 the water level came back to only 250 ft. Although the water level shown for 1936 is considerably lower than that for 1910, there has been a gradual rise in the past few years, largely due to the many large dams, check dams, and large spreading areas, all for the purpose of controlling the run-off.

The utilities supplying natural gas find that the sale of gas to the gas engine users in agricultural districts is most desirable. This for several reasons: namely, the exceptionally good load factor, the load seldom, if ever, causing an excessive hourly peak. The latter condition is due to the installation of equipment sized to meet the load requirements. Another advantage to the utility is the fact that this is a summer load and can be sold in competition with other sources of power at rates considerably higher than those to the industrial consumers operating on the surplus schedules.

On the company's system there are hundreds of engines ranging from six to 400 hp. Some of the small installations operate only 10 to 14 hours a day, while the larger installations, having a greater horsepower demand, operate 24 hours a day during the entire irrigating season. This is particularly true of the mutual water companies and pre-cooling and refrigerating plants.

The duration of the irrigating season is governed by the distribution and amount of rainfall, and rainfall has a direct effect upon the amount of gas consumed in natural gas engines pumping water for irrigation. Fig. 2 shows the duration of the irrigating season; the number of days of irrigation per year for the past 28 years, with the seasonal average 7.15 months, maximum 10 months in 1925, minimum 5 months in 1927. Fig. 3 shows the effect of rainfall on gas consumption. The latter chart covers the scale, on the system, of gas for use in gas engines only. It was just about 18 years ago that transmission lines were extended to agricultural districts; hence the beginning of this chart.

The first consumers to use gas for power purposes were those who had used fuel oil engines which were converted to the use of gas for pumping water. Each year several thousands of horsepower in natural gas engines were connected to replace other sources of power, and for new water development projects. As Fig. 3 indicates, the company has some winter load, this being held up by the addition of several thousands of horsepower in internal combustion engines which replaced other sources of power in pre-cooling and refrigerating plants, municipal plants pumping water for domestic purposes, and industrial plants. The refrigerating load is exceptionally desirable, as it occurs in the same summer months as does the irrigation load, (average 7.15 months per year), the load factor being approximately 100 per cent during that time, while during the remainder of the year the operation is but 50 per cent of that in the summer months.

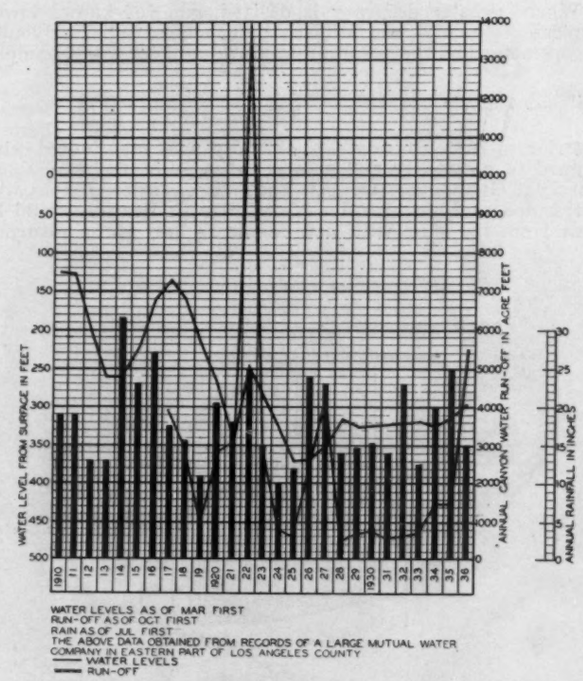

WATER LEVEL FROM SURFACE IN FEET
ANNUAL CANYON WATER RUN-OFF IN ACRE FEET
ANNUAL RAINFALL IN INCHES
WATER LEVELS AS OF MAR FIRST
RUN-OFF AS OF OCT FIRST
RAIN AS OF JUL FIRST
THE ABOVE DATA OBTAINED FROM RECORDS OF A LARGE MUTUAL WATER COMPANY IN EASTERN PART OF LOS ANGELES COUNTY
WATER LEVELS
RUN-OFF

FIG. 1. Chart showing variation in water levels rainfall and canyon run-off.

* A Report of the Sub-Committee on Servicemen's Training, Distribution Committee, Technical Section, Pacific Coast Gas Association.

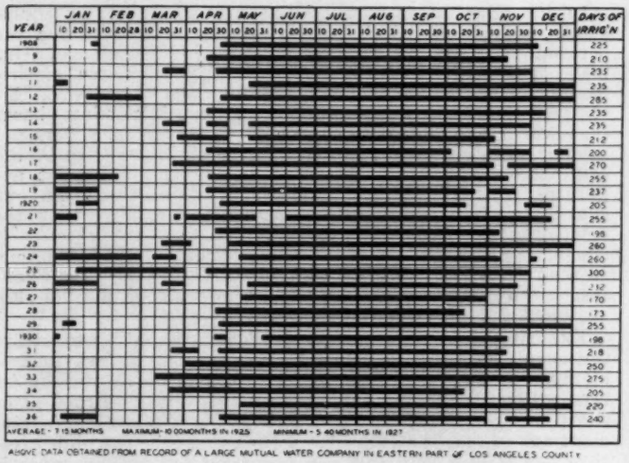


FIG. 2. Chart showing duration of irrigation.

During the winter months a considerably higher rate is applied to all users of natural gas engines.

Gas engine installations are made for two principal reasons. The first is the economy of operation as compared with other sources of power—the realization of the economy effected by the use of natural gas engines being dependent upon a good seasonal load factor. The second reason is the continuity of service and r.p.m. flexibility, the latter being particularly advantageous to the irrigationist, as pumping levels vary as much as 200 ft. during a season's operation. Flexibility is also very desirable in the refrigerating plants for the varying compressor speeds.

A large percentage of the gas engines sold replace other sources of power, and, as the service rendered the users of purchased power is excellent, equally good service is expected when using a gas engine. Realizing that a certain amount of servicing is required to keep the engines operating at the highest efficiency, and also realizing that in the majority of cases, the user of the gas engine is not prepared to do his own servicing and is reluctant to spend money for such servicing, it was considered advisable to render service to the consumer, without charge other than for repair parts that may be needed from time to time. Establishing this service was quite an undertaking as our total horsepower load was increasing each year and the major point to be considered was the matter of cost.

From our experience over a period of years in servicing some 40,000 connected horsepower in natural gas engines owned by consumers on our system, we found that one of the problems confronting us was to determine the amount of service we should render. So far we have been quite liberal, and our cost has been reasonable. We find there can be no fixed basis on which to figure the amount of service to be given. One thing that affects the establishing of a fixed rule for the amount of service is that an engine may require practically no servicing for several years and then need considerable, which would make the cost of servicing for that particular year high, although the average over a period of years would be low. At this point it would be well to mention that we do not obligate ourselves to give this service. We give it only where the revenue warrants the expenditure.

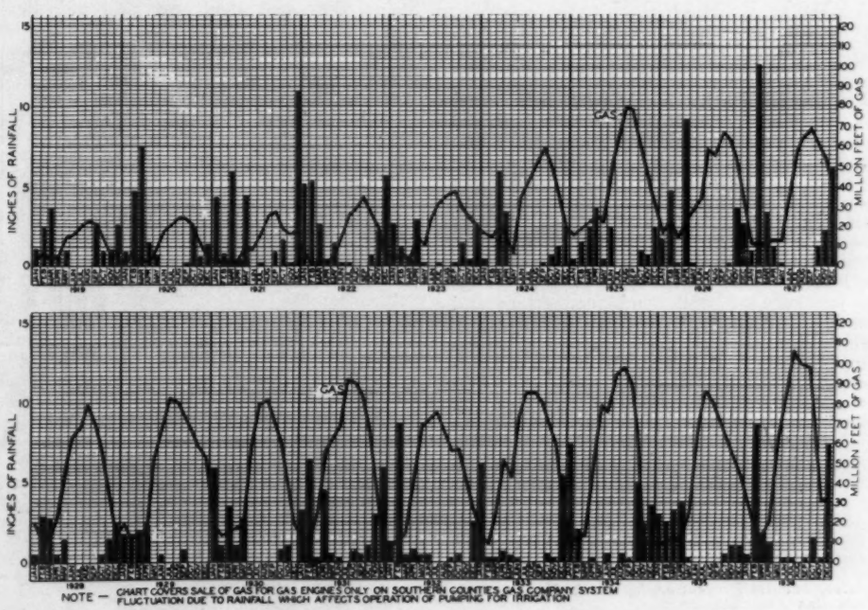
We employ six men to service the engines on our system, five having specified territories assigned to them and one working throughout the entire system, as needed. The work is proportioned as follows to the five men having assigned territories.

Territory	*No. of Engines*	*Connected Horsepower*
1	75	5663
2	110	5907
3	65	6945
4	178	9568
5	121	6926

The reason more engines have been assigned to some of our service engineers than to others is that there are many converted automobile engines in their territories. For convenience, we rate all automobile engines at 20 horsepower, regardless of the size.

Selecting a satisfactory service engineer is quite a problem, as there are not many men who have had sufficient experience to enter the field of servicing all makes of engines. For that reason, when employing a new man for this work it is necessary to give him a course of training. He should be proficient with hand tools, and should have had at least five years experience in machine shop work and gas engine installation. He should be of the type to be trusted to carry through with his work, regardless of the hour, as the main object is to keep the engines running. He is subject to call 24 hours a day and is more or less on his own. He should be extremely diplomatic, as he comes in direct contact with consumers, and should be of the type to inspire confidence in the consumers, as they must feel he is competent to do the work.

While these men are under the jurisdiction of the General Office in Los Angeles, all gas engine installations are in the outlying territories, within a radius of 100 miles. For that



NOTE — CHART COVERS SALE OF GAS FOR GAS ENGINES ONLY ON SOUTHERN COUNTIES GAS COMPANY SYSTEM
FLUCTUATION DUE TO RAINFALL WHICH AFFECTS OPERATION OF PUMPING FOR IRRIGATION

FIG. 3. Chart showing effect of rain on gas consumption.

reason we have found it advisable to permanently locate the service engineers at or near the center of the particular territory assigned to them. Due to the extended area, it is quite difficult to keep in constant contact with these men, so they are required to make daily reports, explaining in detail the work done and the time spent on each engine serviced. These are mailed to the Los Angeles Office where they are entered in our records. If any matters need our particular attention, we immediately follow through. Our service engineers are exceptionally responsible men who appreciate the fact that each has a certain number of engines in his care and take pride in having these engines run satisfactorily with the minimum maintenance cost.

At the end of each year we prepare reports covering the work done during that year. In one of these reports we segregate the connected horsepower into the following classifications—agricultural, industrial, and municipal—giving the following details of each classification: (1) number of consumers, (2) connected horsepower, (3) M c.f. gas sold, (4) revenue, (5) average rate, (6) average consumer-horsepower, M c.f., and revenue, (7) average per horsepower,—M c.f., and revenue.

Another report gives us the following information, by districts, on each of the three classifications: (1) number of consumers, (2) number of engines, (3) connected horsepower, (4) Mc.f. gas sold, (5) revenue, (6) average rate, (7) service cost, (8) per cent service cost to revenue.

Another report segregates the number of consumers according to revenue derived: (1) $100.00 and under, (2) $100.00-$250.00, (3) $250.00-$500.00, (4) $500.00-$1000.00, (5) 1000.00-$1500.00, (6) $1500.00-$2500.00, (7) $2500.00-$5000.00, (8) $5000.00 and over.

A further report gives us the details of the above, as affecting each service man and each consumer: (1) name, (2) horsepower, (3) service cost, (4) M c.f. gas sold, (5) revenue, (6) per cent service cost to revenue.

From the last report we can readily analyze the cost to us of servicing each consumer. If we find the cost of servicing any consumer is excessive, we then take steps to correct the condition. As stated above, most of our gas engine revenue comes from pumping water for irrigation, so naturally we watch this business quite closely. Our service engineers are requested to run tests at least once a year to ascertain the overall efficiency of the plants. We keep a record of these tests so that we can watch the efficiency of the plants, and if the efficiency of any plant decreases to a point where certain changes would be advisable, we immediately take the matter up with the consumer and make recommendations.

New Dewpoint Apparatus

By ARMOR B. MARTIN

*Montana Power Company**

THE instruments described in this paper were originated by the necessity for direct observation of the aqueous dewpoint temperatures of natural gas under pipe line operating conditions. The Montana Power Co. found, during the first winter's operation following the initiation of gas service to Butte and other Montana cities by means of a 20-in. pipe line crossing the Continental Divide from the Cut Bank Field, that the prevention of the formation of "pipe line ice" made imperative close control of the water content of the gas. The gas left the wells saturated with water at the temperature and pressure of well head production, and freezes were common in "Christmas trees," gathering lines, and regulators. These field production difficulties were solved by individual well dehydrators†, but the operation of a gasoline plant, subsequently installed, resulted in re-saturation with water at the temperature and pressure that the gas left the absorber top. This serious hazard to transmission line operation was eliminated by the installation, in 1932, of the first large volume, high pressure, calcium chloride brine, dehydrator to be applied to a major natural gas transmission line‡.

Initial dehydration research, and later control of equipment, made highly desirable a reliable instrument for the determination of water dewpoints at high pressure. Our inability to obtain such an instrument necessitated experimentation with various homemade devices. This work, instigated by M. A. Hardie† developed some intriguing phases that were a challenge to ingenuity and evolved a personal interest possibly out of proportion to the importance of the original objective. A satisfactorily operating dewpoint apparatus should indicate the water dewpoint to within one degree F., regardless of pressure, and independent of the dewpoints of any hydrocarbons which may be present. It should be rugged, inexpensive, and simple in construction, so that it may be readily disassembled in the field for cleaning or repairs. Its operation should not require unusual skill or talent on the part of the operator.

Experiments were made in the field, attempting to utilize the usual low-pressure procedures. Quantitative gravimetric methods, involving actual measurement of the water by its removal by chemical or physical means, were discarded after short consideration: They require delicate laboratory equipment not suited to field use, and the calculation of high pressure dewpoints from samples expanded to low pressures is not practical. A sample taken at 500 lbs. pressure, with a water dewpoint of 32° F., must be analyzed to approximately one part water in 200,000 parts of gas, by weight or volume, to obtain a dewpoint accurate to 1° F. at the original pressure. Psychrometric and hygrometric methods were also found to be inapplicable because of the narrow range at high pressures and consequent magnification of the errors inherently present near saturation.

The best solution of the problem appeared to be some method involving the direct observation of the temperature at which condensation or evaporation occurs on a thermally controlled contact surface. Theoretically, a split hair distinc-

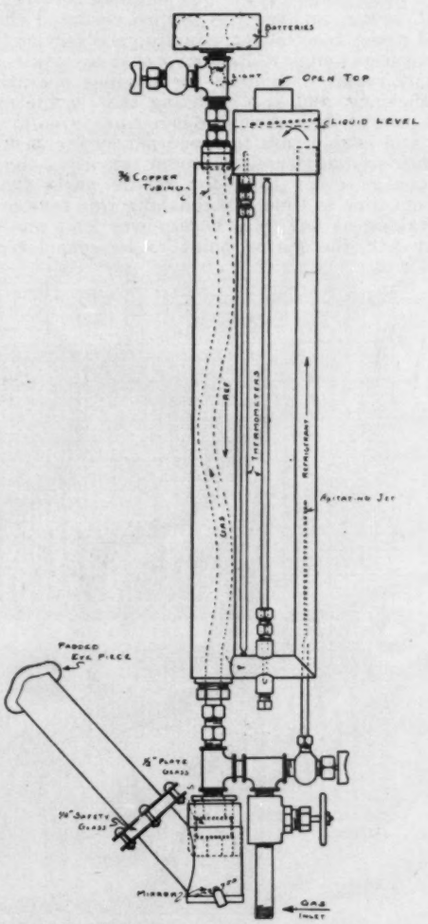


FIG. 1. Plan of helical dewpoint apparatus.

*A Report of the Subcommittee on Pipelines, Transmission Committee, Technical Section, Pacific Coast Gas Association.

†*The Freezing of Regulators and Its Prevention*, by M. A. Hardie, Jr.—1937 Proceedings, American Gas Association.

‡*Dehydration on The Montana Power Company's Transmission Lines*, by R. D. Smith—1937 Proceedings, Pacific Coast Gas Association.

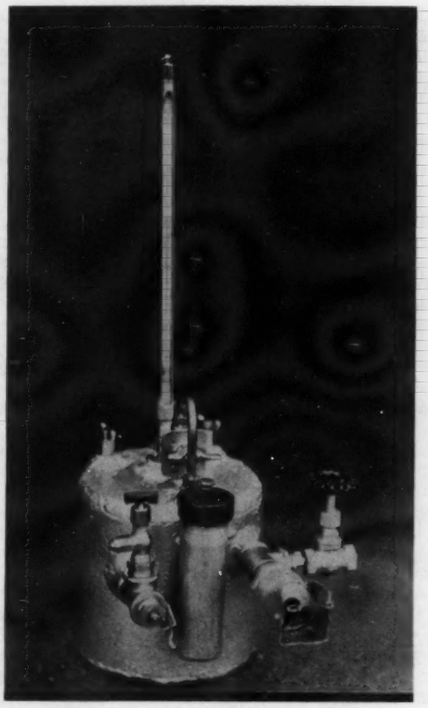


FIG. 2. Tubular reflector dewpoint apparatus.

tion should be made between the temperature of equilibrium and that of dew accumulation, but for the purposes of this paper, they are considered to be identical. The condensation scheme is subject to criticism because, for an actual change of phase to take place, equilibrium cannot exist, and hence there must be a temperature differential below or above the boiling point. Various ideas for minimizing this differential will be discussed later.

A saturating bottle was used to check the various devices tried out. Most instruments, formerly considered to be accurate, were found to be reading low when operated on a gas of known dewpoint. The saturator used in The Montana Power experiments consisted of an 8 in. by 36 in. high pressure cylindrical vessel with small pipe connections at the ends, filled half full of distilled water and immersed in a vertical tank 12 in. in diameter in which constant temperature water was circulated. The assembly was heat insulated and operated in ambient temperatures higher than that of the bath to avoid any possibility of recondensation. Two thermometers were used; one in the bath, and the other in the gas just before it left the bottle. The gas was assumed to be saturated after these two thermometer readings had been identical and constant for at least one hour.

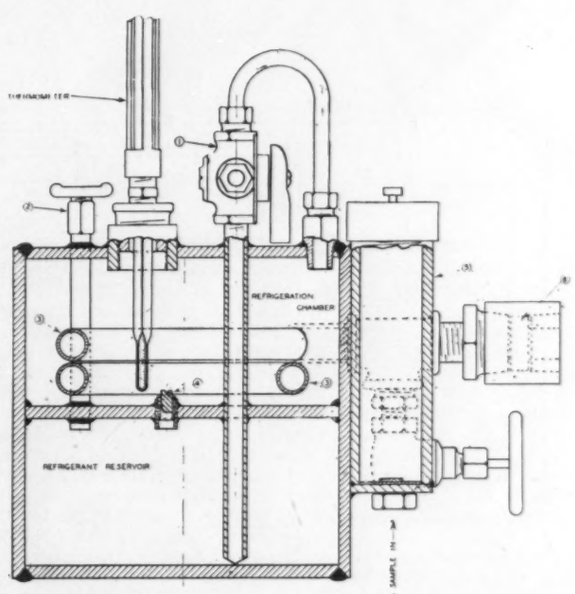
A simple apparatus, consisting of a high pressure glass "U" tube submerged in a jar of casing head gasoline was used for a short time. This had two serious disadvantages: It was none too safe at high pressures, and whenever sufficient condensation had been formed for positive identification, the temperature of the bath was from 2° to 10° lower than the dewpoint, depending on the elapsed time of the test.

Several devices were built using polished metal condensing surfaces of silver or chromium. The most successful instrument of this type is illustrated in Hardie's article referred to above, and consists of a chromium-plated refrigerant cylinder inserted in a stream of gas in a windowed chamber. Hardie used this instrument with marked success to plot hydrate formation curves on Cut Bank gas. Its use for dewpoint determinations was accurate when sufficient time was allowed for condensate to form.

Indication of the dewpoint can be obtained more rapidly with the condensation type of instrument if the polished surface is traced in some regular pattern with a solution of calcium sulphate. This slight contamination is invisible when dry, but, being faintly hygroscopic, will collect moisture and become visible prior to the adjacent clean surface. Another method for the reduction of the temperature differential required to produce observable condensate involves the multiple reflection of diffused light striking the condensing surface at glancing incidence; thus causing an increase in the reflective interference of a trace of condensate and resulting in a marked decrease in observed light intensity.

Two instruments using this idea are illustrated in Figs. 1 and 2. These can be referred to as the tubular reflector type, because the gas and light are passed through a bent metal tube with a highly polished interior. This arrangement has the added advantage of maintaining all of the gas sample at or near the temperature of the condensing surface. Agitated refrigerant surrounds the reflector tube to provide necessary thermal control. The relatively large heat transfer surface contacting the gas, as well as the high heat conductivity of the metal tube, permits the assumption that the temperature of the refrigerant is, for practical purposes, identical with that of the inside of the tube. Although the reflectors are made of copper, they have not been difficult to maintain in operating condition; when operated with Cut Bank gas, which contains only a trace of sulphur and no oxygen, they require swabbing about once a month with metal polish, distilled water, and a dry rag. The apparatus shown in Fig. 1 has had three years of experimental and field use, and the original tube is still in good condition. This reflector consists of two turns of ⅜-in. O. D. copper refrigeration tubing formed in an elongated helix of 1-in. diameter and 6-in. pitch. The amount of bending of the tube is of importance, as the light should be reflected as many times as possible and still remain distinctly visible when the tube is dry. The refrigerant is circulated by a small jet of high pressure gas which also regulates cooling by evaporation. This instrument has the advantage of not requiring any special kind of refrigerant, so that high test gasoline, ether, alcohol, water, or whatever is available to suit the required temperature range can be used.

The device shown in Figs. 2 and 3 contains a ½ in. O. D. copper reflector tube, 23 in. in length, bent one and one-half turns to form a flat helix 4 in. in diameter. It is welded in the upper half of a high pressure tank which serves as a refrigerant evaporator and reservoir. A three-way cock is used to fill the reservoir, transfer the refrigerant from the reservoir to the evaporator, and as a vent for evaporation. Try-cocks on both the upper and lower chambers indicate refrigerant level and prevent over-filling. The evaporator is filled from the reservoir prior to each observation. Whenever the pressure in the evaporator is reduced to cause evaporation, agitation of the refrigerant, which is deemed necessary to assure representative temperature indications, is accomplished by a tiny adjustable bleed which by-passes a small jet of gaseous refrigerant from the reservoir, up through



1. Three way filling and venting valve.
2. Try cock.
3. Helical reflector tube.
4. Agitation bleed valve.
5. Flash light.
6. High pressure glass window.

FIG. 3. Tubular reflector dewpoint apparatus.

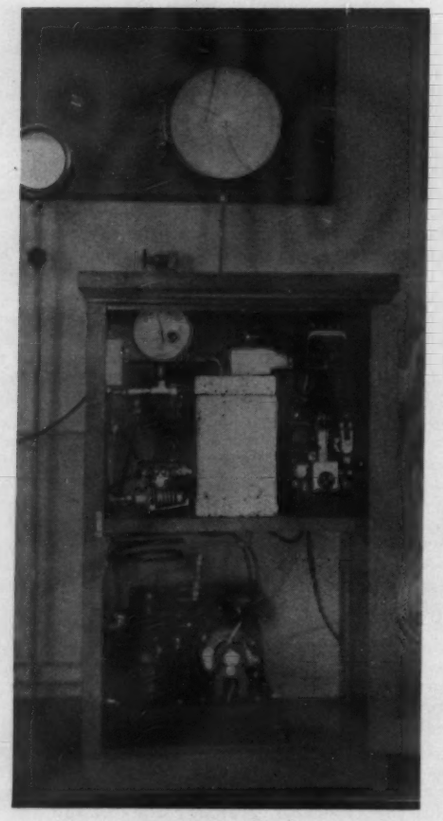


FIG. 4. Recording dewpoint apparatus.

the liquid in the evaporator. Butane-propane is used as the refrigerant; normally five dewpoint observations may be made with one reservoirful of butane. A bare, rather than shielded, mercurial thermometer is inserted in the evaporator to avoid errors due to conduction from the heavy refrigerant tank. Tests indicated that the effect of changing bulb pressures upon thermometer readings were negligible. A two-cell, vapor-proof flashlight, serving as the light source, has the bulb enclosed in a high pressure fitting at the outlet end of the reflector to eliminate an observation window. An adjustable mirror mounted on the window at the inlet of the tube is used to direct the reflected image to suit the convenience of the operator.

Operation of Apparatus

The apparatus is operated as follows: The reservoir and evaporating chambers are charged with butane and the instrument allowed to stand until the refrigerant temperature is at least 10° above any expected dewpoint. Gas at full line pressure is then passed through the reflector-tube at a rate of approximately ¼ cu. ft. of high pressure volume per hour. This rate provides sufficient water for observable condensation without any measurable pressure drop through the instrument. The butane vent valve is then slowly cracked until a rate of temperature drop of about one degree per minute is obtained. The light is turned on and its intensity noted—particularly the distinct outer ring of light reflected from the inside of the nipple that adjoins the window to the tube. If a plain, copper reflector is being used, the light will appear rosy red without any change in intensity until the dewpoint is reached, at which time the outer ring referred to above will be the first to disappear. If the temperature is held at this point for an extra minute, or dropped half a degree, the rest of the light will disappear entirely. The temperature at which the light will reappear after the tube is allowed to warm up will depend upon the length of time that the temperature was depressed below the dewpoint and condensate allowed to accumulate. If the temperature change is reversed at the first fading of the light, it will return to its original intensity within less than 1° F. above the dewpoint.

Some experimenting has been done with this instrument varying the light and reflector conditions. A slight, but definite, reddening of the image will be observed about two degrees higher than the true dewpoint when a normal white Mazda light source is used with a silver-plated or white metal reflector. This phenomenon is not apparent when using a copper tube because of the predominance of red light in the reflection. The anticipation is not accumulative and reaches a maximum within a short time for any particular temperature. Visible loss of light amplitude is negligible until the actual dewpoint is attained; in one instance the reflector temperature was carefully controlled for one hour at ½° to 1° F. above a known dewpoint without any additional loss of light. The temperature was then dropped to ½° under the dewpoint,

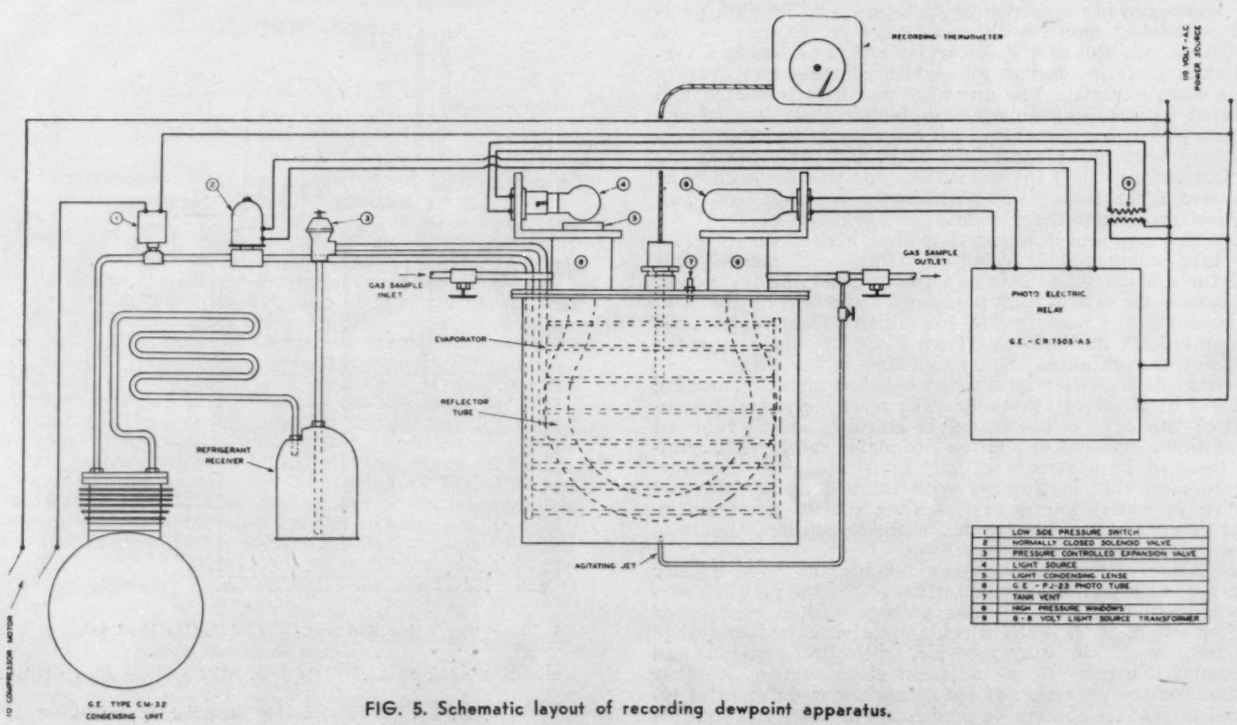


FIG. 5. Schematic layout of recording dewpoint apparatus.

and the light was extinguished in less than a minute. This indication of the selective absorption of the shorter wave lengths of light by some slight film on the reflector surface led to the use of a blue light in a copper reflector; then no reddening of the image was perceptible prior to the dewpoint, but the loss of light slightly below the dewpoint was very rapid. When the temperature and flow conditions were critical, the light would blink out instantly. A red light in a silver reflector gave substantially the same results as white light. The above results are normal in view of the fact that the index of reflection of most metals—especially copper—is much less at the blue end than at the red end of the spectrum.

This anticipatory phenomenon is likely due to the hygroscopic action of traces of impurities contaminating the metal surface of the reflector—either as remnants of chemicals used for polishing, or caused by the oxidation or staining of the tube by some constituents of the gas. An apparatus using multiple reflection between plain surfaces of stainless steel also exhibited this same reaction. Assuming the reflector to be chemically clean, a hypothetical explanation of the above may be that the existence of an adsorbed mono-molecular film of gas and water vapor is increasing in thickness as the dewpoint is approached, due to an accompanying slackening of molecular energy. The work done by Gaudin§ on the identification of minerals by iridescent filming would indicate that the refractive interference of such a slight film with multiple reflection of light striking a polished surface at large angles of incidence could easily account for the selective neutralization of some of the shorter wave lengths. One might also imagine a localized unbalancing of the phase equilibrium of water, wherein a limited amount of liquid water might collect on a heat-removing surface at a temperature actually higher than the true dewpoint. Under these conditions the probable union of slow moving vapor molecules would be enhanced; the coalescence so increasing the surface tension that the resultant internal pressure is sufficient to maintain the liquid phase in almost molecular sized droplets.

The Tubular Reflector Type

The tubular reflector type of apparatus is not accurate for determining a water dewpoint when a hydrocarbon dewpoint exists in the same gas at a higher temperature, although an approximation can be made. The last visible light after a water dewpoint is passed appears as a red pin point in the center of the tube, whereas, in the presence of a hydrocarbon dewpoint, the light is reduced to a faint haziness slightly

§*The Identification of Opaque Solids by Selective Iridescent Filming*, by A. M. Gaudin, Journal of Physical Chemistry, Volume 41, No. 6, June —1937, Page 811.

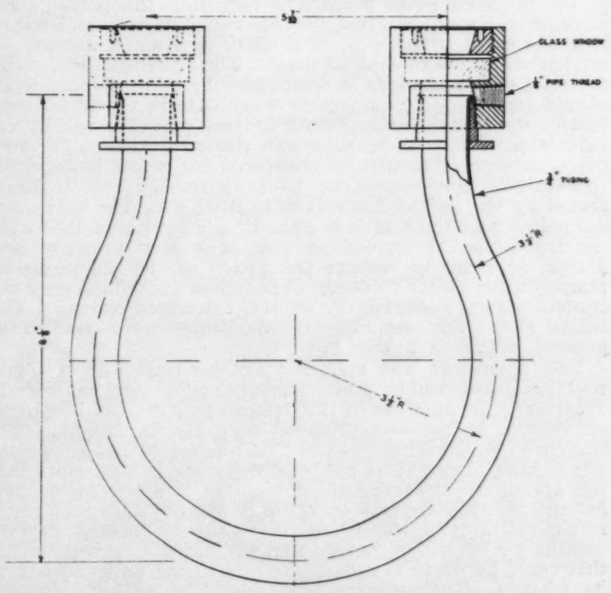


FIG. 6. Reflector tube for recording dewpoint apparatus.

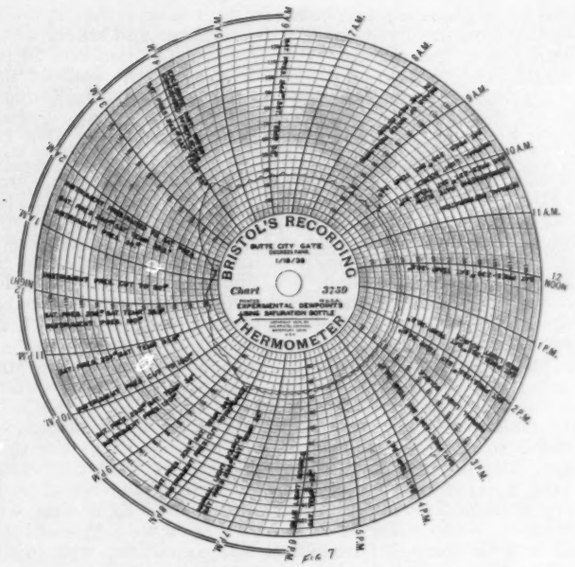


FIG. 7. Twenty-four-hour experimental chart from recording dewpoint apparatus.

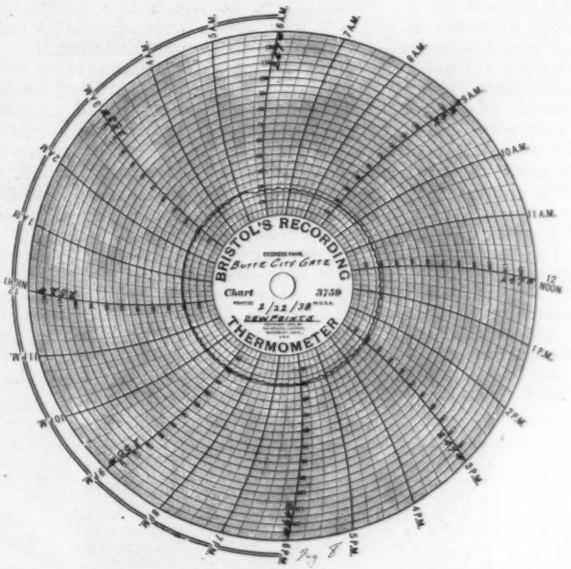


FIG. 8. Typical 24-hour chart from recording dewpoint apparatus.

below the dewpoint, then regains about half of its intensity as the temperature is reduced several degrees. The liquid hydrocarbon, having a much lower surface tension than water, adheres to the walls of the reflector as a continuous film rather than segregating into drops as is the case with water. Light will persist in passing through the reflector even when condensation of a hydrocarbon is taking place at a rate sufficient to run as a continuous stream along the bottom of the tube; it is difficult under such conditions to observe a further diminishing of the light when the water dewpoint is reached, because the relatively smaller amount of water is washed away as it condenses. The water dewpoint can be approximated within 2° F. when the two dewpoints are not more than 10° apart.

A recording dewpoint apparatus has been constructed employing the tubular reflector idea described above. A photo of this unit is shown in Fig. 4 and a schematic arrangement in Fig. 5. Dewpoint temperatures are indicated at intervals as the low points of a cycling record with a standard recording thermometer. The bulb of this thermometer is submerged in a bath surrounding the reflector tube. Bath temperatures are maintained by an electric-driven refrigeration unit con-

trolled by a photo electric relay in such a way that it stops whenever moisture condenses in the reflector and starts when it evaporates. The reflector tube is ¾ in. in diameter, 19 in. in length, and bent as shown in Fig. 6; at the ends of the tube are high pressure glass windows provided with connections for the continuous passing of a sample stream of gas. Attached to one window is a light source consisting of a 16, volt, 32 candle power light; operated at 8 volts for long life. Attached to the other window is a photo electric tube which operates a power relay. The refrigeration circuit consists of a condensing unit, pressure controlled expansion valve, evaporator, and a normally closed solenoid valve. The compressor maintains a set expansion pressure on the evaporator by means of a pressure switch. The photo relay holds the solenoid valve open until the light striking the photo tube is diminished by the collection of moisture. Refrigeration then ceases immediately, and the dewpoint is recorded.

Adjustment of the apparatus is not critical unless readings to less than ½° F. are desired. For a record of operating pipe line dewpoints similar to that shown in Fig. 8, the light source voltage is first set at 6 volts and the relay sensitivity adjusted so that the relay will just pick up when the tube is dry. The light source voltage is then boosted to 8 volts to take care of possible slow tarnishing of the reflector or power voltage fluctuations. The intensity of light that will pass through the reflector shown in Fig. 6 with this adjustment will be about 8 ft. candles. The apparatus will adjust itself to the exact light intensity necessary for opening or closing the photo relay by first accumulating enough water in the reflector to reduce the light to the "drop-out" intensity and then, after warming up once, it will continue to record the dewpoint as the temperature at which this permanent charge of water is slightly increased. Thus automatic compensation is obtained for changes in the condition of the reflector or variations in line voltage. The accumulation of a considerable amount of water in the reflector will cause the up-swing of the record to be high, as the continued presence of excess water lengthens the time required for evaporation. This does not interfere with the accuracy of the indicated dewpoint, as it is read as the low point of registration.

The shape of the registration curve and consequent frequency of dewpoint indication can be controlled by adjusting the rate of change of refrigerant temperature. The rate of cooling is regulated by the setting of the pressure controlled expansion valve. Ambient room temperatures provide the heat necessary for warming when the dewpoint temperature range is lower than 35° F. A very slow rate of temperature change results in a flat cycle covering a longer period with a higher dewpoint accuracy. The amount of the gas sample stream can vary from one-quarter to one cu. ft. per hour of high pressure volume with satisfactory results.

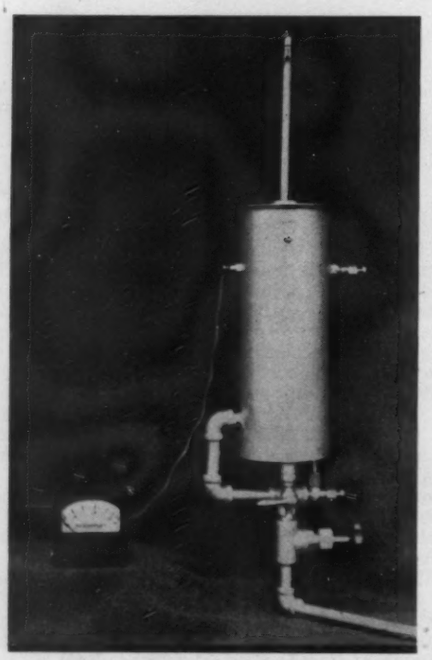


FIG. 9. Electrical dewpoint apparatus.

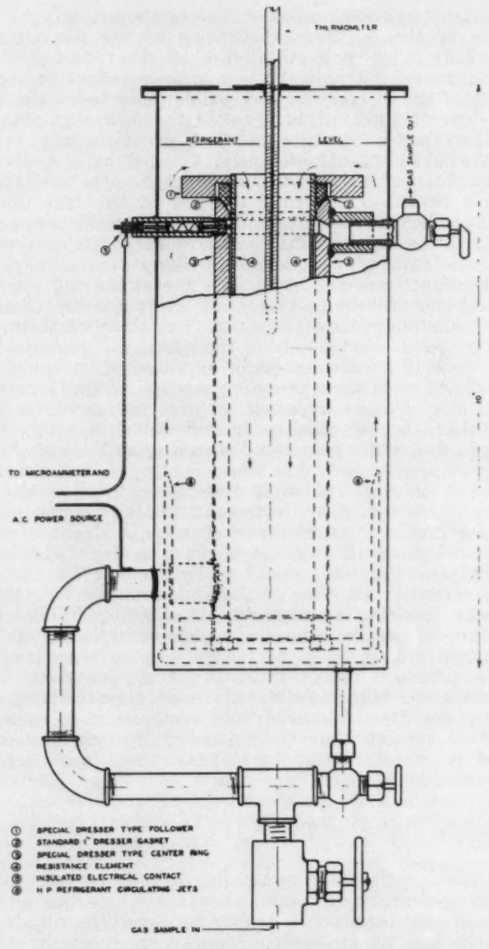


FIG. 10. Electrical dewpoint apparatus.

Fig. 7 is an experimental chart that is indicative of the flexibility of the apparatus. The record shows—between 1:30 and 2:30 p.m. and 6:00 and 7:30 p.m.—that a change in the type of light source has no effect. The anticipating reaction of the reflected light, noticed in operating the portable instruments, does not affect the recording apparatus because it is normally adjusted so that there is a small amount of condensate in the tube at all times. The apparatus will satisfactorily record changes in dewpoint range, but if there is an abrupt increase of considerable magnitude in the water content of the sample, an excessive amount of water will be accumulated before the machine can warm up to the new dewpoint. A wide cycle will be registered for a few hours until this surplus condensate can be evaporated. This is illustrated by the period from 4:00 to 9:00 a.m. The three low dewpoints registered at 9:30 p.m., 12 midnight, and 1:30 a.m., were obtained by expanding gas of higher pressure and known dewpoint to observe the action of the apparatus at temperatures below freezing. These low dewpoints were recorded within 1 degree F. of the calculated values. The record shows that saturation temperatures were checked, in general, within ½ degree F.

This apparatus was built for experimental purposes and contains considerable more paraphernalia than absolutely necessary. In addition to the equipment indicated in Fig. 5, an electric heater was provided that can be automatically turned on whenever a dewpoint is reached to hasten warming at high temperature ranges. A buzzer is also wired into the system to announce the arrival of a dewpoint so that instantaneous thermometer readings can be taken to check refrigeration and recording thermometer lags. Several months of operation have indicated obvious improvements that could be made to reduce the cost of the unit and add to its efficacy. The reflector tube should be either chromium plated or made of stainless steel. The bend can be simpler and shorter, permitting the passage of more light and the

use of a less sensitive photo relay. The windows should be free of any flow fittings to facilitate removal for cleaning; leucite could be used in place of glass to good advantage. The reflector should directly contact the refrigerant in an evaporating chamber, and the by-pass idea for agitation that was used in the portable apparatus, illustrated in Fig. 3, should be applied. A standard refrigeration high-side float between the refrigerant reservoir and evaporator would provide constant level in the evaporator. The condensing unit itself could be dispensed with wherever butane is available for refrigeration. The photo electric relay described was very sensitive, and some operating difficulties were experienced due to voltage drop in the electric service line when

perature tables are available, some worthwhile studies might be made of deviation from Boyle's Law. The actual performance of equipment and materials used for dehydration could be readily verified.

An apparatus based on electrical conductivity was developed in an effort to arrive at some accurate method of determining water dewpoints existing below hydrocarbon dewpoints. This instrument, illustrated in Figs. 9 and 10, contains a resistance element equivalent to a gap 150 ft. long and .0014 in. wide. This is constructed (Fig. 11) by turning a fine semi-circular thread on the outside of a cylinder $1\frac{7}{16}$ in. in diameter and 6 in. long; over these threads is wrapped a single layer of cellophane, followed by a small copper wire

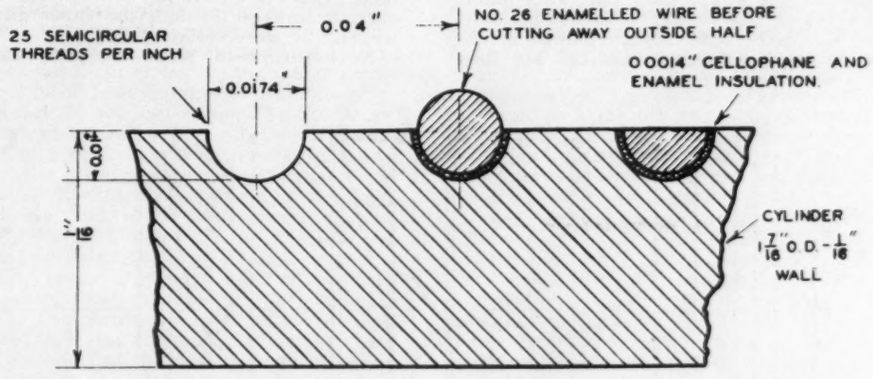


FIG. 11. Detailed section of portion of resistance element used in electrical dewpoint apparatus.

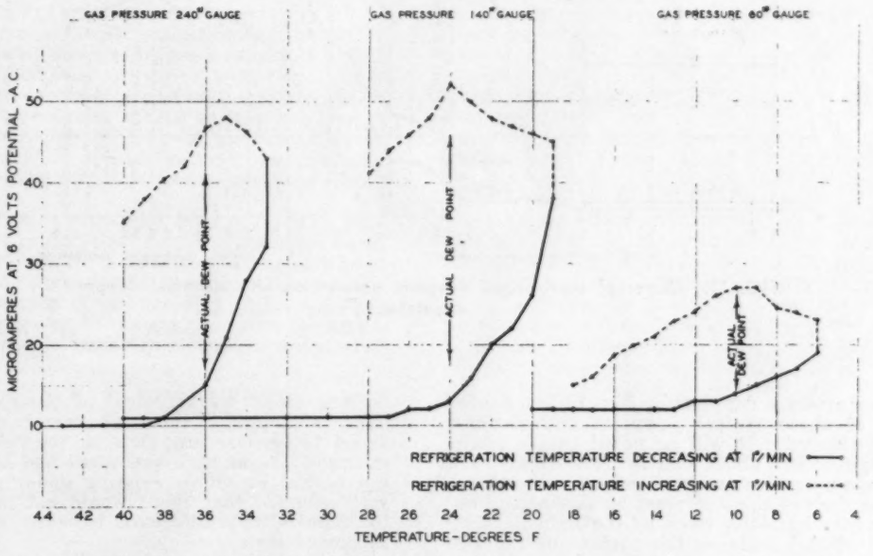

GAS PRESSURE 240" GAUGE
GAS PRESSURE 140" GAUGE
GAS PRESSURE 60" GAUGE
MICROAMPERES AT 6 VOLTS POTENTIAL - A.C.
50
40
30
20
10
ACTUAL DEW POINT
ACTUAL DEW POINT
ACTUAL DEW POINT
REFRIGERATION TEMPERATURE DECREASING AT 1°/MIN
REFRIGERATION TEMPERATURE INCREASING AT 1°/MIN.
44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4
TEMPERATURE - DEGREES F

FIG. 12. Curves of typical dewpoint observations with electrical dewpoint apparatus.

the compressor motor was running; this was eliminated by introducing into the light source circuit a resistance that would cut out when the motor switch closed. Starting surges were overcome by the lag between the time the solenoid valve opened and the low side pressure control closed. If an inexpensive Raytheon Type VR voltage regulator is installed in the photo relay circuit, the solenoid valve and compressor pressure control switch could be eliminated by starting the motor directly from the relay. No replacement of tubes has been necessary to date. The manufacturers claim a life of 25,000 hrs. for the PJ-23 phototube and 15,000 hours for the PJ-8 amplifier tube.

The fidelity of the apparatus when critically adjusted initiates speculation as to its application to some interesting research problems. As accurate water vapor pressure-tem-

drawn tightly into the grooves, and a generous coat of Duco cement. After drying, the outside half of the wire and the exposed cellophane are sandpapered away. It is important that the depth of the threads be slightly more than half the thickness of the wire plus the insulation; otherwise, the wire will tend to burr and short across the cellophane during sandpapering. The element is sealed with standard Dresser gaskets in a specially constructed sleeve as illustrated in Fig. 10. This sleeve is provided with gas sample connections and a small "spark plug," the insulated lead of which contacts the wire on the resistance element. Coarse left hand threads are cut on the interior of the sleeve to ensure turbulence of the sample. This assembly is secured inside a refrigerating tank, wherein high pressure jets cause a positive circulation of refrigerant downward through the inside of the resistance

element. A thermometer is suspended in the center of the element. It is necessary that an electrolyte be present on the element, either as an impurity or by design, in order to increase conductivity when condensation occurs because pure water itself is a very poor conductor. Resistance changes of the element are indicated by an A. C. microammeter with a full scale reading of 80 microamps. A. C. current, to avoid polarization, is used with from 0.5 to 8 volts potential, depending upon the chemical treatment the element has received. Normally the element has a dry resistance, when free of electrolyte, of about 500,000 ohms and gives the best results at six volts. Power is taken from a toy transformer where lighting circuits are available and from a six-volt inverter driven by a car battery when used in the field.

A dewpoint is taken with this apparatus at the same rates of temperature change and gas sample flow that were maintained for the reflector types. The voltage is turned up until a current reading of not more than 10 microamps is obtained with the element dry. Amperage readings are then noted as the temperatures are depressed. Fig. 12 is a reproduction of curves of three typical dewpoint observations, using an untreated element. It will be noted that a slight increase in amperage occurs about two degrees above each dewpoint; in this case no optics are involved, as with the reflector apparatus, so the anticipation must be ascribed to absorption of water, as the humidity rises, by the cellophane insulation and traces of chemicals on the surface of the element. The curve increase at the dewpoint is sufficient to indicate definitely that condensation has taken place. A more precise indication of the dewpoint is obtained when temperatures are reversed after water has accumulated; in which case a marked decrease in resistance infers that the aqueous equilibrium temperature has been exceeded. The rate of change of temperatures should not exceed one degree per minute, or the dewpoint will be over-shot. A progressive flattening of the curves is noted as the dewpoint range declines below freezing. Fig. 13 delineates the results of a prolonged experiment of three hours duration performed with a clean element to determine the accumulative effect of hygroscopicity. An imperceptible amount of water was collected the first 57 minutes, during which time the temperature was dropped from 44° F. to 38° F.; at the latter temperature, which was two degrees above the true dewpoint, the relative humidity of the gas sample had increased to 92.4 per cent. During the time of the next two degrees' drop in temperature, the conductivity increased by moderate steps until the dewpoint was reached. Below this temperature an abrupt change occurred. Upon reversing the temperatures, a reversal was also noted in the curve at and above the dewpoint, similar to the reaction obtained in a normal observation.

Considerable work remains to be done to ascertain the best type of resistance element and its treatment to obtain a maximum change in conductivity at the dewpoint. A highly insoluble salt such as barium sulphate dusted on the surface of the element produces curves synonymous to those discussed above, but the voltage must be decreased to keep the readings within the range of the microammeter. If an element of stainless steel could be built using thinner insulation and a permanent treatment of some highly insoluble electrolyte, improved results should be obtained. The voltages used in these experiments were held as low as compatible with the measurement of small electrical quantities in the field, in an attempt to increase the spread between observable current leakage through the vapor gap and that caused by wetting of the insulation.

No experimental work was performed on any method involving direct measurement of the conductivity of methane gas. Although a thorough search of available literature failed to disclose any data on the relative conductivities of methane gas at high pressures and that of water vapor at the partial pressures existing under pipe line conditions, it was assumed that there would not be sufficient differential to indicate the difference between an unsaturated and a saturated state.

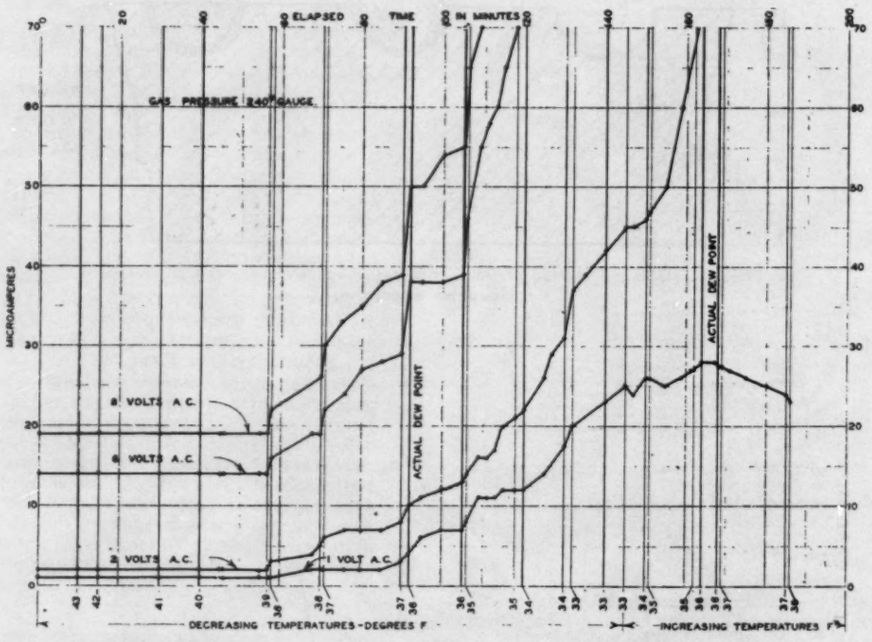


FIG. 13. Curves of a prolonged dewpoint observation with electrical dewpoint apparatus.

Water dewpoints are readily determined with the electrical type of apparatus in the presence of liquid hydrocarbons, although the indications below freezing temperatures are sluggish. Chemical treatment of the element is of considerable assistance in this case.

The foregoing is a resume of the experimental work performed to date by The Montana Power Co. in investigating the measurement of the water content of natural gas at high pressure. What has been done comes far from closing the subject; none-the-less, it has provided us with a satisfactory means of determining that our gas transmission lines are operating with water dewpoints sufficiently low to eliminate any risk to property or service.

The writer acknowledges the valuable assistance of M. A. Hardie, Jr., Gas Engineer for The Montana Power Co., both in the design and testing of equipment and the preparation of this paper.

The devices described in this report are covered by United States Letters Patents, granted or pending with all rights reserved.

The Insulation of Structures Connected to Cathodically Protected Pipe Lines

By H. J. KEELING

*Southern Counties Gas Company**

WHEN cathodic protection is to be used on a pipe line, it is necessary to insulate the line electrically from other structures which are not to be drained. If this is not done, the current entering the protected line from these structures will result in increased operating cost of the cathodic protection equipment. In many cases the current picked up in this way will be of such magnitude that adequate drainage will be impractical if not impossible. The Southern Counties Gas Co. has about 40 cathodic protection stations draining some 160 miles of pipe line. In the majority of these installations, which for the most part are on transmission lines and large distribution feeders, drainage was attempted before they were insulated from other underground structures. However, in no case was it found practical to protect cathodically the lines in this uninsulated condition.

All our pipe lines using cathodic protection have been insulated from other underground structures. The expense involved in accomplishing this was a major item in the construction cost of the drainage stations, and during the past five years a number of different methods were tried in seeking the best and cheapest way of electrically insulating pipe lines. Since there are numerous fittings available for this purpose and a wide variety of opinions among the various companies regarding the best method to be used, this paper will not attempt to deal comprehensively with the general subject of electrical insulation for pipe lines but will merely describe briefly the practices employed by our company.

Although most of our cathodic protection equipment is installed on the older lines, when new lines are installed that are to be protected cathodically or which might eventually be so protected, they are carefully electrically insulated from all other underground structures. Where such a line passes under or over another line, a sheet of canvas-base Micarta is placed between the two. The size of the sheet used depends upon the size of the pipes, but it is never less than three inches square.

All services connected to mains that are cathodically protected are constructed of coated steel pipe and insulated from the house line by means of either a Micarta bushing or a pair of insulated flanges. The insulator is necessary to keep the cathodic protection equipment from draining the water system which is usually connected to the gas piping in the house through the water heater. The bushings or flanges are located between the low-pressure regulator and the meter except in special cases. The 1¼x¾-in. Micarta bushings (Fig. 1) are quite inexpensive; but are not as strong as regular pipe fittings. Our company formerly used bakelite nipples in place of the Micarta bushings now used, but those nipples were not as strong as the bushings and were much higher in cost. Insulated flanges, although more costly, have the advantage that they are as strong as the rest of the fittings in the meter installation. Many of our meter sets are served from a high-pressure transmission line through a high-pressure regulator located at the property line, while the low-pressure regulator and meter are located at the end of a long house line. In such cases the insulated flange is installed at the property line at the outlet of the high-pressure regulator so that it will not be necessary to drain the long house line.

Copper services in sizes from ¾ to 1¼ in. are insulated from cathodically protected mains by Dresser Style 65 fittings used with special rubber sleeves which are slipped over the end of the copper pipe (see Fig. 2). The sleeves have a ring of rubber projecting on the inside which keeps the two pipes from touching. The outside diameter of the rubber sleeve is the same as standard iron pipe so that this fitting may also be used to insulate joints between copper and iron pipe. The fitting is located close to the main, and if possible, all bare metal between the fitting and the main is coated at the time the insulator is put in place.

Coated lateral mains having but few services are usually left connected to the cathodically protected lines, since the cost of insulating all the services is usually less than the cost of installing one insulator in the lateral. Uncoated laterals or coated steel laterals having a large number of services are insulated from cathodically protected lines with either Style 39 insulated Dresser couplings, shop-assembled insulated flanges, or field-assembled insulated flanges made by using insulating bolts in existing flanges. The constructional details of the flanges will be discussed later. Style 39 insulated Dresser couplings (Fig. 3) are similar to standard couplings except that the follower ring has a larger diameter than standard so that it may slip over the special rubber gaskets which cover the ends of the pipes. These gaskets are very similar to the rubber sleeves used with Style 65 fittings. Style 39 insulated Dresser couplings are probably the most inexpensive insulators for large diameters; however any Dresser type of coupling may be used only when both pipes are anchored so that they cannot creep or be pulled out of the coupling. When there is danger that the coupling will be pulled apart, insulated flanges are used.

The special rubber sleeves for insulating copper services from ¾ to 1½ in. diameter are not available for larger diameters; therefore Dresser couplings cannot be used to insulate copper laterals. If a flange connection is not available in which insulated bolts can be used to make a field-insulated flange, a shop-insulated flange is installed as near the lateral off-take as possible. The flanges and all exposed metal between the flanges and the main line are coated to prevent the pick-up of current from the bare copper.

Two styles of insulated flanges have been developed by our company, shop-assembled insulated flanges (Fig. 4) consisting of standard-sized bolts used with insulating tubes in special Lucas flanges having over-sized holes, and field-

* A Report of the Sub-Committee on Pipe Protection, Transmission Committee, Technical Section, Pacific Coast Gas Association.

TABLE NO. I—ANALYSIS OF STRESSES IN BOLTS OF SERIES 30 FLANGED JOINTS IN STEEL PIPE AS COMMONLY USED BY SOUTHERN COUNTIES GAS COMPANY

(1) Size of pipe, (inches O.D.)	(2) Wall thickness (Inches)	(3) Cross section of metal in wall of pipe (Sq. In.)	(4) Number and size of bolts in series 30 flanged joint	(5) Total cross section of metal in bolts at root of thread (Sq. In.)	(6) Total pressure on blind flange with 500 lb. air pressure in pipe (Pounds)	(7) Stress per sq. in. of metal in standard bolts at 500 lb. air pressure. (Lbs./sq. in.) Column 6 / Column 5	(8)* Stress per sq. in. of metal in standard bolts required to resist pipe contraction due to 50°F. drop in temperature (Lbs./sq. in.) Column 3 / Column 5 × 9,500	(9) Maximum stress per sq. in. of metal in bolts ⅛" smaller than standard diameter, either temperature drop or internal pressure (Lbs./sq. in.)
4½	0.237	3.174	8—¾"	2.416	24,350	10,000	12,500	18,700
6⅝	0.250	5.007	12—¾"	3.624	44,300	12,200	13,200	19,700
8⅝	0.250	6.578	12—⅞"	5.028	66,350	13,200	12,500	17,400
10¾	0.250	8.247	16—1"	8.816	91,325	10,300	8,900	13,500
12¼	0.250	9.817	16—1⅛"	11.088	123,725	11,150	8,400	14,000
16	0.250	12.37	20—1¼"	17.80	198,800	11,050	6,600	14,100

* Stress in one sq. in. of steel bar when both ends are fixed and temperature drops 50°F = 9,500 lbs.

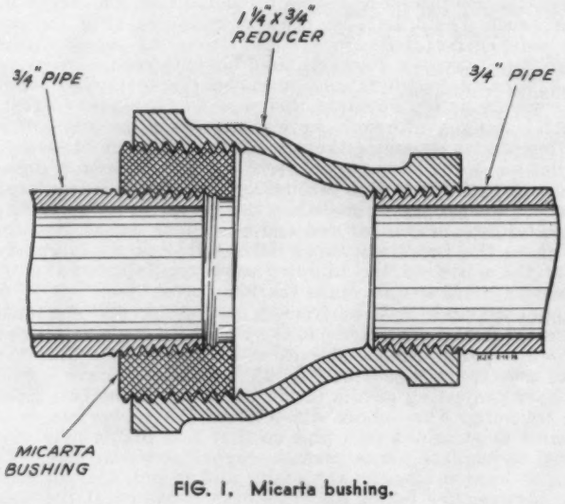


FIG. 1. Micarta bushing.

assembled insulated flanges (Fig. 5) consisting of special insulated bolts with the unused threads machined off, used in flanges with standard-sized holes. These special bolts with insulating tubes attached to them have the same overall diameter as a standard bolt.

The shop-assembled insulated flanges are assembled in our general repair shop complete with gasket, insulating tubes and washers. They are tested after assembly and painted so that they may be fitted directly into the line without being disassembled. It is difficult and expensive to test a buried insulated flange after it has been welded into a line; therefore it is advisable to install a shop-assembled flange in the line without taking it apart. In this way there is no danger that it will become short-circuited during the installation process.

In developing these special insulated flanges, an analysis was made to determine if the strength of the flanges is impaired by enlarging the bolt holes to allow space for the insulating tubes. Calculations disclosed that for all sizes of series 30 welded flanges the bolts are the weakest part of the assembly, and the holes may be enlarged considerably before the strength of the flanges is reduced to any extent. In some sizes, the flanges are subjected to the greatest stress when the pipe contracts due to temperature changes. Under these circumstances the flanged joint will leak before the pipe fails. In other sizes the flanged joint is subjected to the greatest stress due to the gas pressure. In these cases, also, the joint will leak before the pressure is high enough to damage the pipe. Series 30 steel flanged joints of all sizes have less strength than standard weight steel pipe, and when the stress on the flange stretches the bolts sufficiently to allow the gasket to leak, the joint is considered to have failed. Our company, in common with most companies operating transmission pipe lines does not use standard weight pipe in sizes over 4-in. Our pipe lines 6 in. and over in diameter have ¼ in. wall thickness. For pipes of this wall thickness in all sizes over 8⅝ in. O. D., the bolts in the series 30 flanges are stronger than the pipe. This is illustrated by Table No. 1, a tabulation of the pipe stresses induced in the bolts of flanged joints due to either air pressure in the pipe or contraction resulting from a 50° temperature drop. The cross section area of the metal in the wall of the pipe is given in column 3, and the cross section area of the metal in the bolts is shown in column 5. Column 9 illustrates the effect of decreasing the diameter of the bolts by ⅛ in. When this is done, a greatly increased stress is induced in the bolts of the smaller-sized flanges.

Field-assembled insulated flanges (Fig. 5) used to insulate laterals connected to the main through flange fittings, are made by using special insulated bolts and washers in existing flanges. These bolts have the same diameter threads as a standard bolt; however the unused threads are machined off the shank, leaving space for insulating material 1/16 in. thick. They may be installed with normal pressure on the line by removing the standard bolts and replacing them with the insulated bolts one at a time. This feature is important because in many cases it is impossible to take the transmission line out of service in order to install insulated fittings. The only circumstances under which they are not satisfactory is when the gasket between the flanges is of a material that will conduct electric current or when the gasket does not effectively prevent the faces of the flanges from touching, or when metal chips have been wedged tightly in the space between the flanges so that they are short-circuited.

In making a field-assembled insulated flanged joint, if it is possible to put the main out of service, the flange is completely disassembled, and a new gasket of 1/16 in. ungraphited asbestos service sheet is put in place. The inside diameter of the gasket is made slightly smaller than the pipe inside diameter to allow for slight misalignment of the faces of the flange.

The special insulated bolts for use in field-assembled flanges are made by turning standard bolts in a lathe until the diameter of the shank between the head and the base of the nut is reduced to the diameter of the root of the threads. Two split sleeves of 1/32-in. bakelite are forced over the threaded portion of the bolt until they are in place on the turned-down portion. The slit portions of the tubes are turned 180° apart so that there will be no danger that they will line up and leave a portion of the bolt uninsulated. With these tubes in place, the diameter of the bolt at the turned-down portion is brought up to standard. Reducing the diameter of the shank of the bolt to allow space for the insulated tubes does not reduce its strength; in fact, it will have more resilience and will be more resistant to fatigue failure under repeated stress or shock loading than a standard bolt because the stress is more uniformly distributed over the length of the bolt instead of being concentrated at the first two or three threads. If the elastic limit is exceeded and permanent set takes place, it will probably occur in the shank which will cause no particular harm; whereas overloading a standard bolt usually stretches the first two or three threads out of shape so that the nut will no longer fit properly, and the bolt is rendered useless.

It is interesting to analyze the stress in flange bolts resulting from the combination of initial tension due to screwing up the nuts, and external loading caused by gas pressure or pipe line contraction. The question often arises as to the effect of the combined action of this initial tension and the external, or useful load. If the bolt itself could be absolutely rigid, while the flanges which are forced together in screwing it up are resilient and yielded under pressure, the total load on the bolt would be equal to the sum of the initial tension and the external load. If, however, the flanges pressed together were absolutely rigid and the bolt was resilient and yielded, the total (resultant) load on the bolt would be the initial load alone, or the external load alone, whichever is the greater. The first of the above conditions is approached in a flange having a gasket of rubber or other resilient material that expands to original thickness when pressure is removed. The second condition is approached by a flange having no gasket or having a gasket made of lead or some material that will not expand after having once been compressed. In all ordinary practical cases the conditions are somewhere in between these two extremes, so the resultant load on a bolt may be anything between the sum of the initial and external loads as a maximum, and the greater of these two loads alone as a minimum.

The gasket material commonly used in high-pressure gas pipe lines consists of a composition containing tightly packed

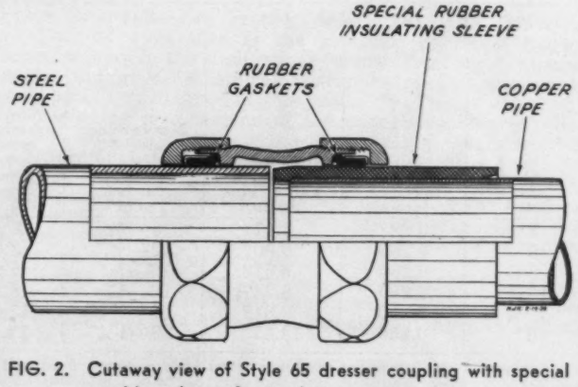


FIG. 2. Cutaway view of Style 65 dresser coupling with special rubber sleeve for insulating copper pipe.

asbestos fibres. When a new gasket is put in place between the flanges of a joint and the bolts tightened up, the fibres are compressed and the material is forced into the small depressions and irregularities in the face of the flange until the surfaces of the gasket conform to the contours of the metal. After once being compressed in this way, the fibres possess very little resilience, and they will not expand to any appreciable extent when pressure is removed from the gasket. The conditions in the average flanged joint, therefore, will usually resemble more nearly the conditions in the ideal flange having no gasket, so the resultant load on the bolts will probably be either the initial tension, or the external load, whichever is the greater.

The factor limiting the strength of a bolted flange is not the ultimate strength of the bolts but the stress under which the bolts will have yielded sufficiently to allow the gasket to leak. When assembling a flange, it is necessary to stress the bolts sufficiently when it is initially made up so that two flanges are brought together with considerable force. If a flange is assembled without initially tensioning the bolts, the external load due to high-pressure or pipe contraction in cold weather will probably cause the gasket to leak because the force on the flanges will be sufficient to separate them slightly by elastically deforming the bolts. This can be remedied by tightening the nuts sufficiently when the flange is made up so that the bolts are stressed nearly to their elastic limit; then the force on the flanges due to high-pressure or temperature changes will not be able to pull the flange away from the gasket unless the bolts are stressed beyond the elastic limit.

When insulating a flanged valve in a long pipe line, it is advisable to install the special insulated bolts in the downstream side of the valve. With the valve closed and the downstream side of the line blown down to atmosphere, the downstream flange bolts will be stressed by the pipe line contraction only. The bolts in the upstream flange of the valve, however, will be subjected to stress from both pipe line contraction and the internal pressure. This is one of the few circumstances where the two loads are cumulative in their effect in stressing the flange bolts.

Before the special insulated bolts which have the excess shank metal machined off were adopted for use in field-assembled insulated flanges, tests were made to determine their strength under actual working conditions, and also to determine the effect of using bolts ⅛ in. smaller in diameter than standard. A 6 in. series 30 flange was chosen for testing. This size was chosen because the stresses in the flange bolts due to internal pressure in the pipe are greater than for any other size, and the set-up for a test under internal pressure is so much simpler than a test based on temperature changes. Two 6-in. flanged bull heads were bolted together and connected up with a hydrostatic pump and test gage. Provision was made to measure the deformation of the bolts by means of vernier calipers. After the flange bolts had been made up, the hydrostatic pressure was increased until the gasket leaked. The nuts were then tightened again and the procedure repeated. This was done several times until the maximum hydrostatic pressure that could be held without exceeding the elastic limit of the bolts had been reached. The tests were made with various sizes of bolts and with both bakelite and iron washers.

The tests disclosed the following facts:

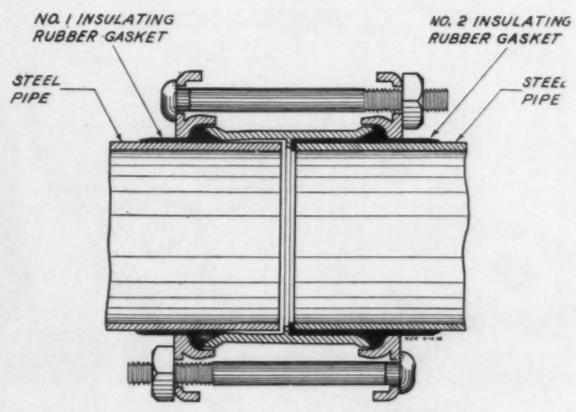


FIG. 3. Style 39 dresser insulating coupling.

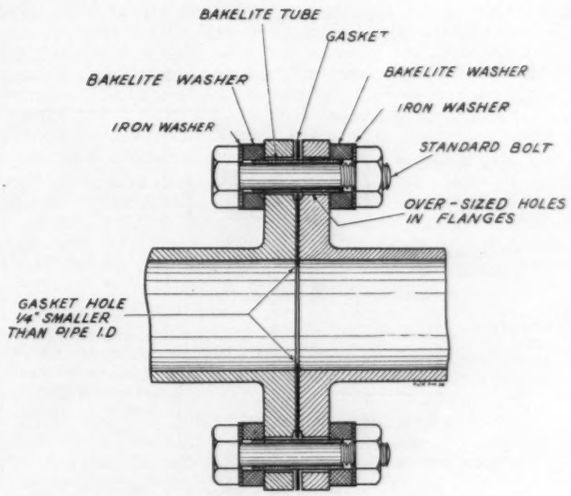


FIG. 4. Shop-assembled flanged joint.

1. Bolts made up with iron washers failed at much lower pressures than did the same bolts when used with bakelite washers. This is probably because the bakelite washers distributed the pressure uniformly over the surface of the nut. Threads on the bolts used with the steel washers were stretched and deformed out of shape while the threads on the bolts used on the bakelite showed no deformation.

2. Standard ¾-in. bolts turned down between the head and the base of the nut to ⅝-in. diameter were superior in strength to standard ⅝-in. bolts.

3. The maximum hydrostatic pressure required to produce leakage in the 6-in. flanged joint under test using the various combinations of bolts was as follows:

a. ⅝-in. bolts with iron washers, 1130 lbs. per sq. in.
b. ⅝-in. bolts with bakelite washers ½-in. thick, 1575 lbs. per sq. in.
c. ¾-in. bolts turned down to ⅝-in. diameter between the heads and the base of the nut, 1800 lbs. per sq. in.

These tests indicated that our field-assembled insulated flanges are of adequate strength provided a bakelite washer is used under the iron washer on the bolts, and provided that the nuts are tightened sufficiently before pressure is applied to the flange.

It is a popular fallacy that high tensile strength alloy steel bolts of less than standard diameter may be safely substituted for the ordinary bolts in a flanged joint, thus leaving space for the insulating tubes required in order to make it an insulated joint. As previously shown it is the elongation of the bolts, not their ultimate strength which determines the pressure at which the joint will leak. The ratio of the unit stress of a material to the unit elongation within the elastic limit is called the Modulus of Elasticity in Tension, or Young's Modulus. The modulus of elasticity is a measure of the stiffness, or rigidity, of the material and not of its strength. It is interesting to note that the stiffness of a strong material may be no higher than that of a relatively weak material. Thus the coefficient of elasticity of all steels, from the softest to the hardest, is about the same—30,000,000. For a given intensity of stress within the elastic limit, therefore, the corresponding strain, or elongation, is about the same for practically all grades of this material. If, therefore, it is desired to replace a steel member with a more rigid one of the same dimensions, nothing is gained by using a harder grade of material. Either the unit stress must be reduced by using larger dimensions or a material must be employed that has a higher modulus. It is not possible to replace a steel member with a smaller one of the same rigidity unless it is made of a material that has a higher modulus of elasticity. Alloy steel bolts will stretch just as far under a given load as will the common steel bolts ordinarily used in flanged joints. If the high-strength bolt is smaller than standard diameter, it will stretch more than the ordinary bolt.

If the external load on the flanged joint is great enough to

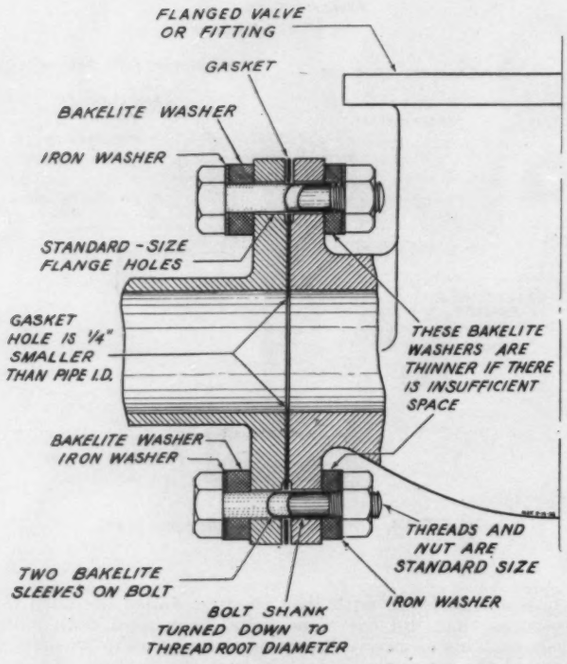

FLANGED VALVE OR FITTING
GASKET
BAKELITE WASHER
IRON WASHER
STANDARD - SIZE FLANGE HOLES
GASKET HOLE IS 1/4" SMALLER THAN PIPE I.D.
THESE BAKELITE WASHERS ARE THINNER IF THERE IS INSUFFICIENT SPACE
BAKELITE WASHER
IRON WASHER
THREADS AND NUT ARE STANDARD SIZE
TWO BAKELITE SLEEVES ON BOLT
IRON WASHER
BOLT SHANK TURNED DOWN TO THREAD ROOT DIAMETER

FIG. 5. Field-assembled flanged joint.

exceed the elastic limit of the common bolts, they will take a permanent set and so relieve the strain. With the smaller diameter alloy steel bolts, however, the yield point is much closer to the ultimate strength, so this stress-relieving set does not take place and the bolt remains in tension. An extra-heavy load may subsequently cause the bolt to break without the warning provided by a leaking joint. This danger, and the fact that there is always a factor of uncertainty in the strength of the alloy steel bolts because of rigorous heat-treatment requirements, makes their use undesirable in insulated flanged joints.

Operating Efficiency of Pilots on Househeating Equipment

By JAMES P. DRESEN

*Public Service Company of Colorado**

FREQUENTLY, the gas used in maintaining pilots on househeating equipment has been termed a gross waste and considered one of the major causes for high-bill complaints, yet little thought has been given to just what the pilots do toward actual heating of residences. Usually, the gas consumption of pilots is so small that the average occupant cannot detect any material benefit. However, actual measurements show far different results.

In order that accurate information could be obtained on this subject, several appliances, including a floor furnace, a circulating heater, a gravity warm-air furnace, and a forced warm-air furnace were set up in the laboratory and operated with only the pilot burning. Following these laboratory tests, similar investigations were made of several househeating installations where excessive pilot consumptions could have materially affected heating estimates. To insure that equilibrium conditions were attained, all appliances were operated with only the pilot burning for at least 12 hours before any determinations were made.

Stack-loss determinations formed the basis for efficiency calculations since air-flow measurements on warm-air systems were almost impossible to obtain accurately. Air-temperature readings were taken at the cold-air inlet to and at the bonnet or warm-air outlet of the appliances. On hot-water boilers, the boiler-water temperature was recorded.

Two charts were made up and used for stack-loss determinations. Fig. 1 is an enlarged section of the lower end of an Ostwald chart based on Denver natural gas. This is extremely useful in accurately determining the percentage of excess air where the percentage of carbon dioxide in the flue gases is extremely low. Fig. 2 is a stack-loss chart based on Denver natural gas and atmospheric conditions. It may be noted that this chart is based on the assumption that none of the water vapor in the products of combustion is being condensed. This was found to be true in every appliance tested.

The gas consumption of the pilots on the various appliances tested varied from .75 to 6.98 cu. ft. per hour. Various rates of gas were also burned on the same pilots to obtain data on the effects of increased pilot consumption. Following is a summary of all tests made as a result of the survey:

1. The per cent of excess air on the appliances tested varied between 850 and 5800 per cent. An increase in pilot consumption materially reduced the excess air.
2. The stack-temperature rise above room temperature varied from 11° F. to 101° F., the greater the pilot consumption, the higher the temperature rise.
3. The stack loss varied from 16.2 to 39 per cent, the average being about 28 per cent.
4. Appliances with combustion-air supply doors developed materially higher efficiencies of pilot gas burning by reducing the excess air.
5. Circulating-air temperature rises as high as 13° F. were recorded on the circulating heater and gravity warm-air installations.
6. Boiler water was maintained as high as 30° F. above room temperature by the pilot flame.

In summarizing the findings, the following general conclusions were reached:

1. Gas burned by a pilot burner, regardless of the rate of consumption, supplies useful heat to a residence at an efficiency not far below that normally obtained when an appliance is operating at rated input.
2. Heat from the pilot flame is supplied to the residence by natural circulation of the heating medium and by radiation from the appliance.
3. The only time that the heat liberated by pilot flame becomes a total waste is during extremely mild days when no heat is required.
4. Heat from the pilot flame maintains a circulation in an appliance sufficient to aid combustion during the first few minutes of operation. This is definitely advantageous where an appliance is thermostatically controlled.
5. Pilot flames should be sufficiently large to insure stability under all conditions and in no case should they be adjusted so small that any stoppage in the pilot orifice might cause delayed ignition of the main burner.
6. Pilots should be located in an appliance so that there cannot be any interference between the pilot flame and main burner flames. Frequently, improper pilot location causes excessive production of carbon monoxide even though there is an adequate supply of air for complete combustion.

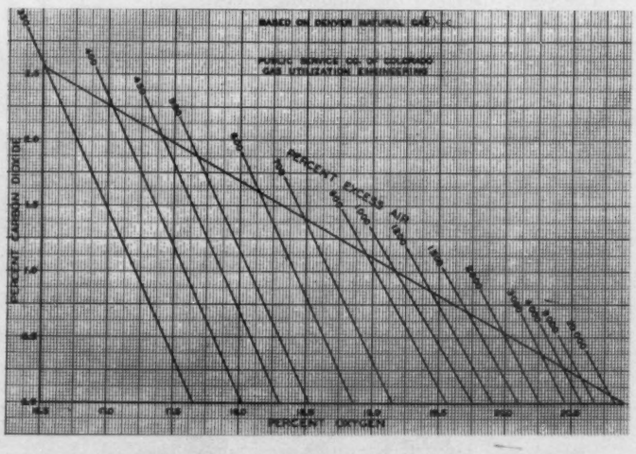


FIG. 1. Ostwald chart for flue gas analysis based on Denver Natural Gas.

* A Report of the Sub-Committee on Gas Appliance Testing, Utilization Committee of the Technical Section, Pacific Coast Gas Association.

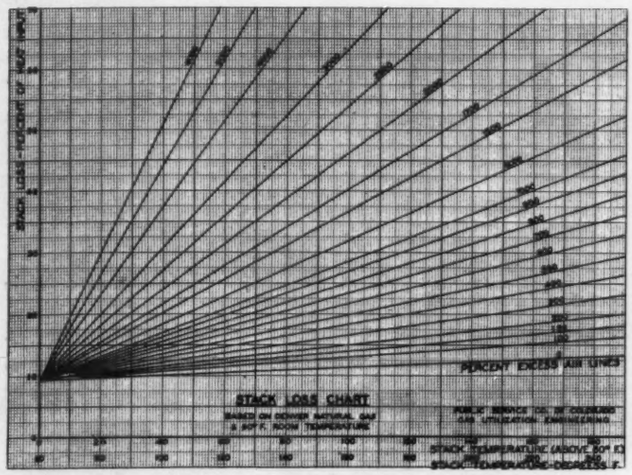


FIG. 2. Stack-loss chart based on Denver Natural Gas and atmospheric conditions.

7. Even though tight closure of a combustion-air supply door will materially increase pilot operating efficiency, too rapid or too complete closure of this door may cause the pilot to be smothered out by the flue gases from the main burner.

Items 5, 6, and 7 are mentioned only because they should be given consideration when attempting to increase the efficiency of the pilot flame.

It is generally accepted that pilot gas on water heaters supplies a good share of the radiation loss from the appliance, yet this gas is not burned at nearly as high an efficiency as the pilot gas on the average warm-air furnace. This is because the excess air is usually greater and the stack temperature higher, both being caused by the hot water establishing a good draft through the appliances and the flue gases being a few degrees higher than water temperature.

Safety always should be given first consideration when adjusting the height of pilot flames. It should be stressed that unduly large pilot flames are not advocated but they should be sufficiently large to insure proper stability and to effect rapid and positive ignition of the main burners. Even in extreme cases where unusually large pilot flames must be maintained to insure safety, it should be kept in mind that the heat produced therefrom is being used to definite advantage and at an efficiency in keeping with good practice.

The Application of Gas to Summer Air Conditioning

By GLEN MILLER

*Southern Counties Gas Company**

IT IS not the purpose of this paper to outline or enter into any discussion of cycles of operation or strictly air-conditioning problems or system design. For such information may I refer you to a paper by Jared A. Hill, published in the P.C.G.A. Proceedings, Vol. 28, p. 46, to the outline of 411 large air-conditioning systems presented in the February, 1938 issue of *Power*, and to the numerous articles published both in the gas magazines and by the respective manufacturers of different types of equipment.

The function of this paper is to accept as already understood and developed certain general classes of gas-using air-conditioning equipment and to endeavor to ascertain the proper application for each of these classes of equipment.

It is not within the scope of this paper to consider the winter phase of air conditioning but only the more limited field of summer air conditioning, and then not to consider the problems inherent in the air-conditioning design, but only those problems which arise because of the substitution of gas-using equipment for certain equipment in which the conventional design employs electric-driven or steam-operated equipment.

There are available today some five general classes of gas-operated air-conditioning equipment. These are:

1. *Gas engine driven compressor.* In this type of equipment the entire system design is conventional except that a gas engine is substituted for the electric motor driving the compressor. Auxiliaries may be tied to the central gas engine or be driven by electric motors using purchased or generated power.

2. *Absorption systems.* The ammonia absorption system is available today for gas operation through the medium of a steam boiler utilizing steam as a heating plant. There is also a thermally more efficient absorption machine employing lower pressure steam and certain organic refrigerants and solvents.

3. *Moisture removal systems.* A number of systems which either absorb or adsorb moisture from an air stream are available. Among these are silica gel, lithium chloride, aluminum oxide; in fact, any deliquescent salt or moisture absorbing material may be used. For example, concentrated sulphuric acid may be used. These systems do not in themselves refrigerate but only convert a latent load to a sensible load.

4. *Steam jet systems from gas-fired boilers.* At the present time both low and high pressure steam jet systems are available, and theoretically it is entirely feasible to build a jet system using other refrigerants than water. To the writer's knowledge, however, such systems have never been commercially employed.

5. *Other gas-actuated systems.* There are a number of other potential gas-operated systems which will be described later, none of which has as yet reached any commercial prominence or application. Bearing in mind that general air-conditioning design is at least fairly well established, the problem of application is merely one of where and to what extent these gas-actuated systems above described should be inserted into conventional designs.

Gas Engines

The gas engine as motive power for compressors in a typical system design is the first thought when considering the application of gas to summer air conditioning. Although the number of installations in the country using gas engines is very limited (out of 411 systems of over 50 tons each installed since January 1, 1936, only one is gas engine driven) the experience of our company and other companies in the application of gas engines to other types of power load offers a valuable fund on which to draw.

The gas engine should be applied to air-conditioning compressors only where constant attendance or at least expert periodic inspection is available. This attendance or expert periodic inspection can be handled in three ways: The consumer may take care of it, the gas company supplying the fuel may take care of it, or the vendor supplying the equipment originally can take care of it. In general, it is not feasible in small plants for the consumer to maintain or purchase attendance or inspection service. It is not, in small plants again, economical for the gas company to offer such attendance or inspection service, due to the low revenue per season per horsepower. On a basis of 1000 equivalent full hours of operation per season and 10 cu. ft. of gas per brake horsepower hour and a typical gas rate, $3.30 would be returned to the gas company in gross revenue per horsepower per season. As a general rule, the original vendor of air-conditioning equipment has neither the qualified service men nor the experience to make a satisfactory source of the required periodic inspection.

It seems to us, therefore, that the gas engine is best applied to jobs which are large enough to justify continuous attendance, and experience in the Middle West has shown that these jobs are those of over 50-ton capacity. On a 50-ton job with a plant generating auxiliary air-conditioning power as well as other light and power requirements, a very satisfactory operating condition can be obtained. It was my good fortune to inspect personally some half dozen of these plants in the Middle West last year, and I found that excellent results at a very low cost per delivered ton-hour were being maintained. Even in such plants, however, great care must be used in selecting and properly applying the natural gas engine. For

*A Report of the Sub-Committee on Air-Conditioning, Utilization Committee, Technical Section, Pacific Coast Gas Association.

further information on this point, may I refer you to C. Remschel's excellent articles published in *GAS* (January, 1937, p. 13 and April, 1937, p. 32).

The limiting conditions to gas engine application are the problems of supply of cooling water, noise, vibration, and of course relative energy costs and first costs.

The gas engine plant will require approximately 25 per cent more cooling water than the electric motor plant, and of course if cooling water is a marked problem in plant design, this 25 per cent increase may prove to be difficult. The problems of noise and vibration are the same as are found in other types of gas engine application, and competent engineering can generally reduce them to a minimum.

No general rule for a limiting condition in energy costs can be laid down in the case of the gas engine as it can in the case of the absorption system, but in the matter of first cost it will be found that if adequate care is given to the selection of a proper gas engine, the unit cost will rise rapidly on small jobs, placing the gas engine job in an unfavorable competitive light to the smaller installation.

Absorption Systems

The older conventional absorption refrigeration machines which could supplant the compressor and condenser of the conventional system have played no part in the air-conditioning field so far. I refer to the water vapor concentrated sulphuric acid machine which has been obsolete for 40 to 50 years and to the sulphur dioxide absorption machine. Due to ammonia not being usable as a direct expansion refrigerant in the air-conditioning field and the subsequent necessity of using a subsidiary refrigerating medium, there are few if any air-conditioning plants using ammonia absorption refrigerating machines.

The Williams Air-O-Matic absorption machine, available in sizes up to 20 tons, has reached some application when used in conjunction with both gas-fired and oil-fired low pressure boilers. This machine is still in the developmental stage. Probably as many as 50 installations have been made throughout the United States, and judging from the present equipment and the experience of those few installations, this type of machine is very well adapted to the small job (up to 20 to 30 tons) and particularly adaptable where it is desirable to use steam heat for winter heating. In California the size of the boiler for heating compares very favorably with the size of the boiler for operating the refrigeration machine in the summer time. Should residential air conditioning become an important phase of the summer air conditioning business, it is my opinion that machines of the Williams type offer not only the best gas-using equipment available but the best equipment of any type available to do this job.

The limiting factors in the substitution of the organic refrigerant direct expansion type of absorption machine for the conventional reciprocating or centrifugal compressor refrigerating machine are very important and must be borne in mind in every job where the application of these machines is considered. Cooling water is the principal limiting factor from a strictly technical point of view. The conventional machine requires the dissipation of 240 to 250 B.t.u. per minute per ton of refrigeration, while the Williams absorption machine in its present stage of development requires the dissipation of about 520 B.t.u. per minute per ton of refrigeration. In other words, cooling water requirements are twice as great, cooling towers must be twice as large, twice as much water must be pumped, and in certain installations this factor alone may prohibit consideration of the absorption machine.

Available temperature range is another very important limiting factor in the absorption machine of the Williams type. Capacity of the machine drops off rapidly with evaporator temperatures below 40 degrees, and for certain types of lower temperature industrial air conditioning the machine is definitely not applicable.

The third important limiting factor is the fuel-energy balance. Considering a typical conventional machine of approximately average performance and using round figures, the conventional machine will require about one horsepower ton and about one-tenth horsepower per ton for cooling water circulation, or a total B.t.u. input at the meter (considering line loss, shaft loss, motor loss, belt loss), of approximately 3740 B.t.u. per hour per ton of high grade energy in the form of power. The absorption machine, again using round figures and considering average performance, will require about 20,000 B.t.u. per hour in the form of low grade heat energy, one-tenth horsepower per ton for the absorber pump and two-tenths horsepower for water circulation. This is equivalent to some 1020 B.t.u. per hour per ton of high grade energy in the form of power and about 25,000 to 28,000 B.t.u. per hour per ton in the form of low grade heat energy, again at the meter. In other words, the cost balance lies between 2720 B.t.u. of high grade energy and 25,000 to 28,000 B.t.u. of low grade heat energy. Converting this to a basis of actual cost, if the average rate for electricity is 1c per kw. hr., the rate for gas to make the operating cost feasible must lie between 2.94c per therm and 3.68c per therm. As a general consideration from a strictly cost standpoint, this type of absorption machine is applicable only where the cost of high grade energy in the form of power is from eight to 10 times greater on a B.t.u. basis than the cost of low grade energy in the form of fuel.

In plants of above 20 tons, first cost becomes the limiting factor because whereas conventional machines tend to drop off in unit cost as the size of the plant rises, the cost of absorption machines of the type now available does not have this tendency.

Moisture Removal Systems

Bearing in mind that moisture removal systems, with the possible exception of one or two obscure undeveloped chemical reagent systems, do not reduce refrigeration load but merely convert latent load into sensible load, it is safe to say that the moisture removal systems are applicable in general to high latent load jobs where the required dew point is very low, accurate humidity control jobs, very low dew point jobs other than high latent load jobs, particularly such industrial jobs as might arise where de-humidification is required at the same time heating is required, and particularly to well water cooling jobs.

In localities where well water is available at a low lift and at a temperature at least 10 degrees lower than the desired room temperature, the moisture removal systems afford a relatively inexpensive, very flexible, easily controlled installation, giving complete summer air conditioning. In California, Arizona and Nevada particularly, aside from special installations, the moisture removal systems have their chief potential application to such industrial jobs as the silica gel system installed on the Southern Counties lines in the City of Santa Monica for maintaining a low dew point in the automatic switching room of the telephone office.

It is very difficult to outline any definite set of limiting conditions for the moisture removal systems as was done for the absorption systems because at the present time these systems must be considered as available for strictly special applications.

Steam Jet Systems

In consideration of the applicability of conventional jet refrigeration systems we will limit the discussion to steam jet systems as being the most commercially feasible. The conventional steam jet system requires steam at a pressure of around 80 lbs. per sq. in., although the Pacific Gas and Electric Co. has a Ross Decalerator installed and operating at a pressure of 10 lbs. per sq. in. steam pressure. We will consider these two classes, namely high pressure (over 15 lbs. per sq. in.) and low pressure systems (under 15 lbs. per sq. in. steam pressure) separately.

High pressure steam jet systems operated from gas-fired boilers are particularly applicable at this stage of development where the load is large, the demand relatively constant. Generally speaking, gas rates for firing high pressure boilers are especially low, and this should prove an added incentive to the development of high pressure steam jet systems. Naturally, this system will find its easiest application in places where high pressure boilers are already installed.

The low pressure systems have not as yet reached any general application; they are too new for any particular consideration at this time. Generally speaking, however, these systems can be operated without the services of an expensive licensed steam engineer and have a potential field of application on jobs where low pressure heating boilers are at present installed or on new jobs where low pressure steam heating is called for. It seems at this time that generally the low pressure steam jet system should supplement the absorption system and be used on the larger jobs where the absorption system is not applicable.

The limiting conditions or factors for both high and low pressure steam jet systems are the same, and again perhaps the most important is that of cooling water. It is re-

quired to dissipate between 500 and 600 B.t.u. per minute per ton of refrigeration in the steam jet system and in some jobs, as was the case with absorption machines, this factor may prove to make the steam jet system uneconomical. The auxiliary power required is in excess of that required for either compression refrigeration or for absorption refrigeration, due to the fact that power is required to circulate the water from the tank to the cooling coils, as this liquid serves as the refrigerating medium. As a first approximation, we might say that the cost of low grade fuel energy for steam jet systems must not be higher than one-tenth to one-twelfth the cost of high grade power energy.

Temperature is a limiting factor, as the low practical limit of steam jet systems is about 40° F., due to the extremely low pressure which must be maintained and the consequent low temperature cooling water required. Present indications are, at least in jobs of 25 tons or over, that cost is not an important limiting factor, as the cost of such systems is well in line with the cost of other systems.

Other Gas-Actuated Systems

In the introduction mention was made of other potential gas-operated refrigeration cycles for air conditioning. The use of the Allen dense air machine with a compressor driven by a gas engine and all auxiliaries supplied by power from the cooled compressed air, and pressure air distribution through small ducts to inspirating orifices applied within the room volume in the form of large numbers of small jets, might well have a considerable application to the problem of air conditioning, except for high power input. The power required for the Allen cycle under certain temperature and pressure limits may be five or more times greater than the power required for the conventional cycle and consequently, although the first cost might be expected to be very low, I see little possibility for the development commercially of this type of machine.

Permeable membrane jet pump machines, which operate without any auxiliary power except for cooling water circulation, have been patented by a German concern. It is possible that the future may see some development of this machine which would be commercially practical. It is quite possible that the Von Platen Munters machines (the Electrolux cycle) might be developed at least in small sizes utilizing electric motor driven cooling water circulation pumps. This cycle is not particularly efficient, however, and might not be able to compete commercially on account of cost. Intermittent absorption machines are available, but as air conditioning is necessarily a continuous process, it seems logical to believe that unless there are some new developments in this field, the intermittent operation machine would find difficult competition in first cost because of the necessity of duplication of equipment. Were it not for the difficulty of handling the concentrated sulphuric acid, the old original water vapor sulphuric acid machine might make a very nice air-conditioning refrigeration machine, but I feel that we must consider this as a strictly theoretical possibility and not look for any commercial development.

The general conclusions which can be drawn from the above are that we may expect engine sets to be most applicable to jobs of greater than 50-ton capacity with electric auxiliary drive either purchased or generated by a separate machine, for if a separate machine is not used for generation, we lose the possibility of modulated control which will be discussed in a later article. In applying engine sets it must always be borne in mind that either constant attendance or frequent inspection, such as will anticipate service troubles, will be found to be essential.

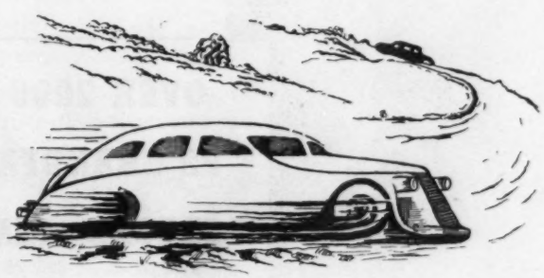
Absorption machines will find their most general application at 20 tons or under, with 30 tons probably as an outside limit unless the commercially available machines should be radically changed in their design. It must be borne in mind that this type of machine is ideal and superior to any other available equipment for residential use. We refer here to those machines using Freon refrigerants.

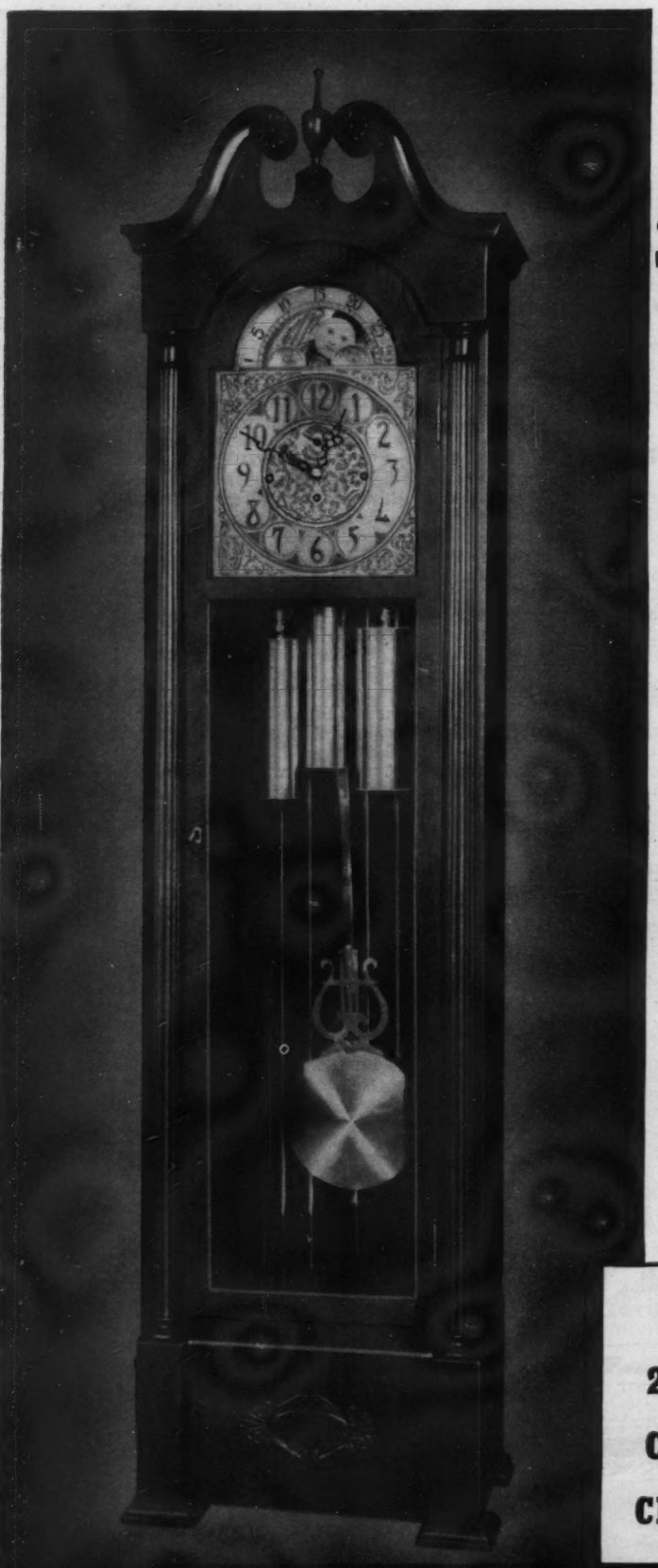
Moisture removal machines will be found applicable in the Southwest only to very special problems, as in general the latent load factor in West Coast installations is low. This statement does not apply, however, to theatre, large auditorium, or crowded restaurant jobs.

Steam jet machines of the high pressure type will be found generally to be applicable to large jobs where there is an engineer in charge, where boilers are already in, where the gas rate is low, as for example in lemon storage rooms, large commercial jobs, etc. Low pressure jobs may well be found to take up the slack between the absorption job and the gas engine-powered job and may be found to be a very valuable type of equipment in this range.

I should like to propose at this time as subjects for more specific inquiry by the air conditioning committee:

1. The problem of control of all types of gas engine jobs: (a) Where the sensible and latent load vary in a fixed relation to each other, and (b) where the sensible and latent load vary independently.
2. The gas cost problem, with specific relation to inducement rates.
3. The question of whether auxiliary power on gas engine jobs should be purchased or generated.
4. The question of whether auxiliary power on high pressure steam jet jobs should be purchased or generated by condensing turbines.
5. Can combination high pressure steam generation by uniflow engines and low pressure steam heat winter air conditioning be applied economically to large building installations using gas-fired high pressure boilers on special inducement rates or on surplus rates? Can all other building power be economically picked up from these same generation machines?
6. Can absorption refrigeration machines for air conditioning be developed so as to be directly gas-fired?





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APRIL . . . MAY . . . JUNE. Three big months! And they're going to be bigger than ever this year. For your refrigeration committee is backing you with the most extensive activity yet staged—the "Make Every Minute Count" Campaign. It will help you *make every minute count* for gas refrigeration sales. It will bolster your gas load for years to come.

In this Time-ly sales drive, there will be literally thousands of awards—for both companies and men. Every company, every man will have a chance.

To your company, *Time* spent selling the gas refrigerator brings its reward in the form of greater load and provides a mighty bulwark against the loss of load to competition. This great "Make Every Minute Count" Campaign will help make that Time *well* spent. It will invigorate your entire sales force, will intensify efforts, will help you achieve a record-smashing sales year.

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Write to **H. R. STERRETT,** *Chairman*
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AMERICAN GAS ASSOCIATION
420 Lexington Ave.
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"Make Every Minute Count" **IN 1938**

Stanley Jenks, Utility Man, Is Named Editor of GAS

STANLEY JENKS, for many years prominent in both the gas industry and the journalistic profession, has been appointed as editor of *GAS*, effective last March 15. Mr. Jenks, who will maintain his office in New York City, brings to his new position a background of practical experience with the gas industry and its problems.

STANLEY JENKS

Mr. Jenks first entered the gas industry in 1920 as cadet engineer with the Northern Indiana and Electric Co., Hammond, Ind., and in that capacity organized the company's advertising and publicity department, being appointed manager. Shortly after this company became the Northern Indiana Public Service Co., he was appointed sales manager and served in that capacity until 1935 when he became the Eastern manager for Bastian-Morley Co.

Long active as a veteran member of the American Gas Association, Mr. Jenks has been prominently identified with many of its commercial activities. In 1931 he served as national chairman of the Association's water heater committee and in 1933 was chairman of the Mid-West Gas Sales Council. He has appeared on many gas convention programs throughout the country.

During the World War, Mr. Jenks saw considerable active service with the British Cavalry and Tank Corps. He was wounded four times and retired with the rank of Captain to join the staff of the London Times. His experience since coming to the United States in 1920 has been in the utility and gas business.

■ ■

Name Committee To Finance Gas Industry Exhibit

Under the leadership of Norman R. McKee, president of the Pacific Coast Gas Association, preliminary financing has been completed for an exhibit of gas equipment for the Golden Gate International Exposition. Additional financing for the design, construction, and operation of the exhibit will be in charge of the following special committee: Chairman, R. E. Fisher, vice-president Pacific Gas and Electric Co.; H. R. Basford, president, H. R. Basford Co.; H. L. Farrar, president, Coast Counties Gas Co.; Don Fleming, Electrogas Division of Payne Furnace and Supply Co.; C. R. Graham, secretary, James Graham Manufacturing Co.; R. A. Hornby, vice-president, Pacific Lighting Corp.

■ ■

Penn York Natural Gas Corp. Will Construct New Line

The Penn York Natural Gas Corp., Buffalo, N. Y., has been authorized by the New York Public service commission to exercise franchises for the construction of a gas transmission line in Steuben, Allegany, Wyoming, Erie, Cattaraugus, and Chautauqua counties. The approval is given nunc pro tunc as the line was constructed in 1936 without the commission's approval.

Extending for 133 miles, the transmission line will furnish natural gas from Harrison field, Pa., to the Republic Light, Heat and Power Co. which serves natural gas in Chautauqua, Erie, Genesee, and other western New York areas. The line goes through 23 towns and no gas is to be supplied to any of these towns and none sold to owners of land through which the line runs.

■ ■

S. E. Dillon Dies at Hot Springs, Ark., In March

Stephen E. Dillon, 71 years of age, died March 12, of a heart attack at his home in Hot Springs, Ark. For the past 30 years Mr. Dillon had been vice-president and general manager of the Hot Springs Public Utilities.

CALENDAR

April, 1938

A. G. A. Distribution Conference—Netherland Plaza Hotel, Cincinnati, Ohio, April 4-6.

Pacific Coast Gas Association, Spring Technical Conference—Los Angeles, Calif., April 7-8.

New Jersey Gas Association — Asbury Park, N. J., April 12.

Midwest Gas Association—33rd Annual Convention, Hotel Lowry, St. Paul, Minn., April 11-13.

Eastern District, American Petroleum Institute—William Penn Hotel, Pittsburgh, Pa., April 14-15.

American Chemical Society, Division of Gas and Fuel Chemistry—Dallas, Texas, April 18-21.

Southwestern Gas Measurement Course—University of Oklahoma, Norman, Okla., April 19-21.

Missouri Association of Public Utilities—Jefferson Hotel, St. Louis, Mo., April 20-22.

May, 1938

Pennsylvania Gas Association—Sky Top Lodge, Sky Top, Pa., May 3-5.

A.G. A. Natural Gas Department—Roosevelt Hotel, New Orleans, La., May 9-12.

International Petroleum Exposition—Tulsa, Oklahoma, May 14-21.

Indiana Gas Association 1938 Convention—Hotel Gary, Gary, Ind., May 16-17.

A. G. A. Commercial and Hotel and Restaurant Sales Conference—Belmont-Plaza Hotel, New York, N. Y., May 23-24.

American Petroleum Institute, Midyear Meeting—Wichita, Kan., May 23-25.

A. G. A. Production and Chemical Conference—Hotel Pennsylvania, New York, N. Y., May 24-26.

Association of Gas Appliance and Equipment Manufacturers — The Greenbrier, White Sulphur Springs, W. Va., May 25.

The Institution of Gas Engineers—75th Annual General Meeting, London, England. May 31-June 3.

June, 1938

A. G. A. Executive Conference — Palmer House, Chicago, Ill., June 2-3.

Canadian Gas Association—31st Annual Convention, Royal York Hotel, Toronto, Ont., Canada, June 9-10.

Pacific Coast Gas Association, Northwest Conference—Portland, Ore., June 16-17.

Society of Chemical Industry, Annual Meeting of all Sections—Ottawa, Canada, June 20-22.

New England Gas Association Sales Conference—Viking Hotel, Newport, R. I., June 23-24.

American Home Economics Association—William Penn Hotel, Pittsburgh, Pa., June 28- July 1.

September, 1938

Pacific Coast Gas Association—45th Annual Convention, Santa Barbara Biltmore Hotel, Santa Barbara, Calif. Week of September 12.

October, 1938

A. G. A. Twentieth Annual Convention—Atlantic City, N. J., week of October 10.

A. G. A. E. M. Appoints Agee Promotional Sales Manager

R. S. AGEE, of Washington, D. C., has recently been appointed by the Association of Gas Appliance and Equipment Manufacturers to the position of promotional sales manager. Mr. Agee will move his headquarters to New York where he will assume his new duties about April 1. His first project will consist of planning the program for the coming nation-wide promotion of the modern gas range through a co-ordinated drive by manufacturers, utility companies, and dealers.

R. S. AGEE

For the past three years Mr. Agee has served as utility and sales promotion manager for the Washington Gas Light Co., Washington, D. C.

■ ■

Rochester Gas and Electric Purchases Three Companies

The Rochester Gas and Electric Corp., Rochester, N. Y., on March 16 completed the purchase of two natural gas companies and one manufactured gas concern in Monroe County, N. Y. The transaction gives the Rochester company a monopoly of the county business. The purchase price of the franchise and physical properties was $104,000.

The systems now under Rochester Gas and Electric control were formerly operated by the Tri-County Natural Gas Co., the Caledonia Natural Gas Co., and the New York State Electric and Gas Corp. Tri-County, which operated in Wheatland, Caledonia, and Leroy, sold out for $25,000.

■ ■

O'Lenic Named Manager of Hoosier Gas Corp., Ind.

S. V. O'Lenic recently received the appointment of manager of the Hoosier Gas Corp., H. Carl Wolf, president of the company, has announced. The Hoosier Corp. operates in Vincennes, Princeton, and Washington, Ind.

Mr. O'Lenic was formerly associated with the Stone and Webster Service Corp., New York City, as engineer in the rates and analysis department.

■ ■

Lambdin Named Gas Operations Executive for Miss.

Harry Lambdin was recently appointed superintendent of gas operations for the Mississippi Power & Light Co. with headquarters in Jackson, Miss. Lambdin succeeded G. C. Jones, who was promoted to the state engineering department.

■ ■

D. Chris Williams Dies

D. Chris Williams, president, Northern Oklahoma Gas Co., died from accidental shooting at his farm near Ponca City, Okla. Funeral services were held for Mr. Williams in Ponca City.

WEDGEWOOD

HI-BROILER MODEL WINS INSTANT APPROVAL OF WESTERN HOUSEWIVES

The housewife says

"I like this newest Wedgewood Gas Range because it is the last word in cooking convenience. The new high broiler is much easier to use. I never dreamed that steaks could be broiled so tender and juicy. And I never have a cake failure in the new low-temperature—high speed oven. The lovely porcelain enamel is a joy to keep clean. Friends say my Wedgewood is the most beautiful range they've seen."

The dealer says

"I like Wedgewood Gas Ranges because they are excellently designed and well-built in every detail—an important consideration in keeping customer good-will. Also because they are manufactured on the Pacific Coast exclusively for Pacific Coast conditions."

ONLY WEDGEWOOD HAS ALL THESE FEATURES . . .

ASTOGRIL BROILER AT WAIST HEIGHT
LOW TEMPERATURE — HIGH SPEED OVEN
EXTRA BIG OVEN
SPEED-PLUS-SIMMER BURNERS
EXTRA LARGE COOKING TOP
DOUBLE LIFT-UP COVERS
AUTOMATIC LIGHTING

Gas THE MODERN FUEL

WEDGEWOOD

THE MODERN GAS RANGE
MAKES FRIENDS FOR GAS

JAMES GRAHAM MANUFACTURING CO. • SAN FRANCISCO, LOS ANGELES, NEWARK, CALIF.; PORTLAND, ORE.

"Porcelain Enamel helps us do a better job"

satisfied customers

repeat business

increased business

additional profits

HARBOUR-LONGMIRE COMPANY

MANUFACTURER-INTERIOR DECORATORS-RETAILERS

COMPLETE HOME FURNISHERS

J. F. HARBOUR, CHAIRMAN
W. M. LONGMIRE, PRESIDENT
A. F. WILLIAMS, VICE-PRES.
AUGUSTA H. BAIRD, SEC'Y.

OKLAHOMA CITY, OKLA.

July 20, 1937

Porcelain Enamel Institute, Inc.
612 North Michigan Avenue
Chicago, Illinois

Attention: Secretary McKnight

Dear Sir:

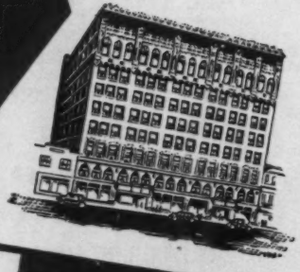
Your booklet entitled "Selling Points for Household Appliances" is very good and I take pleasure in congratulating you on its excellence. It gave me a clearer insight as to the value of porcelain finished products, and permit me to say this: it has been our custom for many years to sell the buying public many full porcelain enamel products; such as, refrigerators, stoves, heaters, and whatnot, and in doing so we feel that we have done them a distinct favor, for the simple but sufficient reason that when we sell porcelain enamel appliances we at once do two important things.

First: a satisfied customer . . . and, it is a well-known fact that satisfied customers bring in repeat business at low cost.

Second: an increase in volume, which, of course, means additional profit at the end of the year.

Having been in business more than 26 years and expecting to remain in business for a long time, we feel the necessity of having satisfied customers. Porcelain enamel helps us do a better job.

Cordially yours,
W. M. Longmire
W. M. Longmire



PORCELAIN ENAMEL INSTITUTE, Inc.
612 North Michigan Avenue, Chicago

DURABILITY BEAUTY AND HEALTH
PORCELAIN ENAMEL
Fused on Metals

PORCELAIN ENAMEL THE Lifetime Finish

Which Man Gets the Breaks In Your Company?

THE president of one of the larger middle western gas companies was once asked "Who gets the breaks in your company?" In other words, what are the qualities in a man that make him outstanding. The president's reply was a short survey of the LAW of personal application to business, which is as follows:—Loyalty, Accuracy, Willingness.

"Loyalty is the spirit," said the president, "which prompted one of our men a few days ago to say, when he was asked what his job was by a friend, who knew he had recently been promoted, that he was still working for the boss . . . the same as he always had been.

"Helping the boss," continued this gas executive, "is the real spirit that wins the breaks. Remember that your boss is helping his boss and so on up the ladder, and he values you by the way you help him.

"Accuracy is necessary in every organization no matter what its size or line. Accurate statements, accurate sales and credit orders, save a lot of time and trouble for other people. Accuracy wins your friends because you make other people's jobs easier.

"Willingness is the good salesman's specialty. Self-starters were not necessary on automobiles when they were introduced. They were welcomed because they made it easier for the driver. The willing salesman is an asset in the organization, for he makes the departmental wheels turn with far less friction. Besides, the world is full of 'belli-aikers' and troublemakers, who are no good to themselves or the people around them."

These words come from a man whose record proves the merits of the LAW he advocates, for he has risen from the ranks, climbed obstacle after obstacle, and today has the wholehearted confidence and respect of the organization which he directs.

■ ■

Public Service Co. Offers Home Building Contest

The Public Service Co. of Northern Illinois, Chicago, is currently sponsoring a Home Building and Modernization contest, which is open to home owners, architects, builders, and realtors. Twenty-four cash awards, totaling $4800, are offered to direct attention to sound construction, good architecture, quality materials, approved equipment, and "Better Living" in the company's territory.

Homes on which work was begun after February 1, 1937, and which will have been completed between August 15, 1937 and October 31, 1938, may be entered in the contest.

SALES SLANTS

A month by month presentation of experiences on the sales front.

A Lesson in Addition

THE difference between salesmanship* and the lack of salesmanship could not be better explained than in this little example, cited the other day by the district manager of a well-known stove company.

Two candy stores operate in the same neighborhood. One is run by a pleasant Greek, who apparently understands child psychology. Youngsters having a few pennies to spend invariably visit the Greek's in preferance to the other store.

Watching the proprietors work, the answer is obvious. In the first store (not the Greek's) the proprietor always puts a bag of candy kisses on the scale, then *removes* a few kisses to arrive at the proper weight. In every case the young purchaser reveals his disappointment as he sees several kisses taken out of the bag. (Taking candy from a baby, so to speak).

Now, what happens in the Greek's store? When the young candy purchaser comes in, the wise Greek puts only a few kisses in the bag, and then he begins to *add* more and more, until the proper weight is attained. Result —bright, shining eyes, complete satisfaction, and a very happy youngster.

In neither case does the purchaser receive more candy than his money would buy. But the Greek, being a good salesman, understands the value of emphasizing the "plus" values in selling.

Says this A-1 salesman: "De keeds like to see me putta more candy in de bag!" What a bang-up record that fellow could make selling *anything!*

■ ■

* Excerpt from a sales letter distributed February 4, 1938, by the Philgas Department of Phillips Petroleum Co., Detroit, Mich.

KANSAS CITY JOURNAL-POST
PHONE VICTOR 6000
53
HOLLYWOOD SELECTS THE MODERN ALL-GAS KITCHEN
See
-and
HOLLYWOOD'S MOST SENSATIONAL MODERN KITCHEN
All-Gas Equipped!
IN HAL ROACH'S M-G-M PICTURE
Merrily We Live
Now Showing at LOEW'S MIDLAND
WE LIVE BETTER, TOO, WHEN GAS DOES THE 4 BIG JOBS!
In Designing Their Sets Hollywood Selects the Most Modern, Up-To-Date Equipment!
KANSAS CITY GAS CO.
A Cities Service Company
CO-OPERATING GAS RANGE DEALERS

A.G.A. Advertising Program Features Hollywood Tie-in

The current American Gas Association advertising program is taking advantage of the tie-in value of the recent Hal Roach feature comedy, "Merrily We Live," which includes a battery of three gas ranges and three electrolux refrigerators. To give gas glamour, the A.G.A. has urged that gas appliance dealers and gas companies throughout the country convert regularly scheduled newspaper advertising space to special tie-in copy featuring the picture, when it opens in towns served by each company.

Typical tie-in advertising is illustrated in the advertisement, at left, of the Kansas City Gas Co., designed for local newspaper publication. Another type of tie-in suggested in the national program is the use of appliance displays in the theatre lobby and mezzanine wherever "Merrily We Live" is showing. Show cards featuring the "glamour kitchen" from the picture may also be used for dealer floor display.

Franklin T. Rainey, Ohio Fuel Gas Co., Columbus, Ohio, chairman, Program Committee; Eugene D. Milener, secretary, Industrial Gas Section, A.G.A., New York, N. Y.; C. B. Mershon, Manufacturers Light and Heat Co., Pittsburgh, Pa.; Thomas E. Wood, Manufacturers Light and Heat Co., Pittsburgh, Pa.; John P. Brosius, Equitable Gas Co., Pittsburgh, Pa., were delegates to the Industrial Gas Sales Conference.

More Than 150 Gas Men Meet for A.G.A. Industrial Gas Sales Conference

HELD under the auspices of the Industrial Gas Section, American Gas Association, Hale A. Clark, Detroit City Gas Co., Detroit, Mich., chairman, the Industrial Gas Sales Conference at the William Penn Hotel, Pittsburgh, Pa., attracted more than 150 natural and manufactured gas men from all over the country. Among the highlights of the conference was the discussion prompted by a paper entitled "Penetrating the Industrial Air-Conditioning Market" by F. M. Johnson, Kathabar Div., Surface Combustion Corp., Toledo, Ohio.

Opening Monday morning with Mr. Clark presiding, the keynote address was made by Charles E. Bennett, president, Manufacturers Light & Heat Co., Pittsburgh, Pa., on "The Desirability and Value of Industrial Gas Business" which stressed the fact that the most important job today was sales. He also developed the subject of an economic balance between domestic and industrial gas sales.

Alexander Forward, A.G.A. managing director, paid tribute to the industrial gas men in an address, voicing appreciation of their work.

The development of an improved type of crucible gas furnace for melting brass was described in a joint paper "Improvements in Crucible Melting With Gas" by Ralph D. Hawkins, The Bridgeport Gas Light Co., chairman, Non-Ferrous Metals Committee and Oliver D. Pritchard, The Brooklyn Union Gas Co., Brooklyn, N. Y.

"Immersion Heating Capitalizes the Advantages of Gas for Soft Metal Melting," by Elmer B. Dunkak, C. M. Kemp Manufacturing Co., Baltimore, presented data on large volume, soft metal melting in tin pots in tin plate mills, big lead pots, stereotype pots in newspaper plants, lead pots in heat treating and other applications. Karl Emmerling, The East Ohio Gas Co., Cleveland, contributed his successful experiences with tin plate pots in steel mills in his territory.

An informative case history in "A Discussion of Up-to-Date Gas Forging Practice" by M. W. Martin, Public Service Co. of Indiana, Indianapolis, gave details of a series of tests on oil-fired forging furnaces.

The Industrial Gas Men's luncheon was to be addressed by Joseph McKinley, vice-president in charge of sales, Equitable Gas Co., Pittsburgh, but due to sickness his address was delivered by G. W. Ousler, general sales manager, of the same company. A tribute was paid to the industrial gas salesmen and the necessity for steady intelligent effort in the manufacturing field was stressed.

The Monday afternoon session opened with Frank H. Trembly, Jr., Philadelphia Gas Works Co., and vice-chairman, Industrial Gas Section, presiding. Harvey C. Weller, Surface Combustion Corp., spoke first on "A Discussion of Gas in the Glass Industry." He told of how forced convection heating, successful in modern industrial furnace applications in other fields within the temperature ranges of 600 to 1200 deg. F., has been applied to gas lehrs with good results. Most important result was the elimination of the muffle.

The relative merits of "Long and Short Gas Flames in Industrial Heating" were then related by A. M. Capper, Continental Roll & Steel Foundry Co. Points in favor of the long luminous flame were: an increased rate of transfer; more uniform temperature; less maintenance of refractories and less oxidation or scaling. Information on these points was given, leading to the conclusion that the long flame was the best for many applications.

Paul J. Ziegelbaur, Detroit City Gas Co., spoke briefly on "A Study of Propane and Butane as Industrial Fuel."

Karl Emmerling, The East Ohio Gas Co., Cleveland, presided Tuesday morning. The first paper was "New Developments in Applying Gas to Decorating Kilns" by Philip Dressler, Swindell-Dressler Corp., Pittsburgh, who described the gas decorating kiln recently installed at the Lenox potteries at Trenton, N. J., heated with gas radiant tubes. Ralph L. Manier, Central New York Power Corp., Syracuse, N. Y., told about bisque and glost kilns in Syracuse, and C. B. Mershon stated that a circular type kiln, 30 ft. in diameter, at the Shenango Pottery was heated by this method.

T. W. Halloran, New York Power & Light Corp., chairman, Food Industries Committee, then delivered a valuable paper, "A Discussion of Gas

Hale A. Clark, Detroit City Gas Co., Detroit, Mich., chairman, Industrial Gas Section, and Frank H. Trembly, Jr., vice-chairman.

in Food Manufacturing Industries," which cited the enormous size of the food production industry and classifications were given to indicate where gas might be sold to advantage.

In a paper "Selling Natural Gas During a Recession," by T. E. Butler, The Peoples Natural Gas Co., Pittsburgh, it was shown that the depression made the building of the load possible because prior to that the mills and factories were too busy to take time to convert furnaces, and fuel costs were a secondary consideration.

Franklin T. Rainey, Ohio Fuel Gas Co., chairman, program committee, presiding at the Tuesday afternoon session, first introduced W. N. Blinks, General Gas Light Co., Kalamazoo, Mich., who said that the one method of selling, in his paper, "Proven Methods for Selling Gas Unit Heaters to Factories," is to introduce the idea at the time the plans for a new building are being drawn.

The Kathabar or lithium chloride system of air conditioning with gas was described in a paper entitled "Penetration of the Industrial Air-Conditioning Field" by F. M. Johnson, Surface Combustion Corp., Toledo, Ohio, who told how the same equipment that was used for dehumidification in summer could be used for humidifying and heating in the winter. E. P. Kramer, chairman, gas engine power committee, discussed the subject from the gas engine viewpoint.

■ ■

Servel Cuban Dealers Hold First Sales Meeting

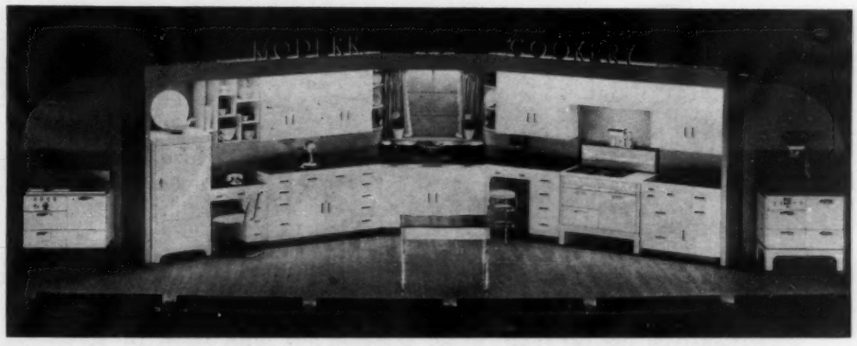
A first meeting of Servel Electrolux Cuban retail dealers who handle gas-operated and kerosene-operated refrigerators throughout all parts of the island was held March 16 at Camaguey, a mid-island city in Cuba, to discuss plans for the 1938 selling season.

All phases of the 1938 selling plans, including advertising and promotion, were discussed with representatives of the Servel export department, who left for Cuba especially to attend the meeting. Attendance was approximately 100 persons, including the Mayor of Camaguey, John A. Elton, assistant manager of the export department of Servel, Inc., and Dario de la Garza, of the same department.

■ ■

E. G. Peabody Heads Sales For Citizens Gas & Coke

E. G. Peabody was recently appointed head of the sales department of the Citizens Gas and Coke Utility, Indianapolis, Ind., to succeed Fred G. Rastenburg who resigned January 1. Mr. Peabody was formerly associated with the Central Indiana Gas Co. where he served as general sales manager for five years. He is a director of the Indiana Gas Association and a member of the American Gas Association.



The traveling kitchen of Consumer Power Co., Jackson, Mich.

Showmanship Features Consumers Power Co. Cooking Show

TO put showmanship into a modern gas cookery show, Consumers Power Co., Jackson, Mich., has built a portable traveling kitchen for stage background, equipped with plenty of light and scenery to back up the company's all-star cast of gas devices and the show's leading star, Mattie Rouse, the home economist. The term, "Modern Cooking Show," with the demonstrator referred to as the speaking star, has been found by the company to carry a bigger punch with the public than the former title of "cooking schools."

Although for many years Consumers Power Co. has been a supporter of cooking schools, the staging facilities in all the cities, small towns, and villages in which company shows have appeared have not always been favorable to good showmanship. D. S. Ford, of Consumers Power, in a recent address before the Home Service Conference of the Mid-West Gas Sales Conference, pointed out that the often drab appearance of the halls and auditoriums available for the show detracted to such an extent that sales results of appliances traceable to the show were questionable.

The traveling kitchen, which has been inaugurated to overcome the above difficulty, occupies, when set up, a floor space 35 ft. by 9 ft., and stands 8 ft. high. No background panel except the sink section is greater in width than 4 ft. All cupboards and counters are dummies and do not include shelves or drawers. The show's lighting load is 3000 watts. The sink is connected with hose to supply both hot and cold running water, while the drain empties into a 10-gal. waste can. These methods of connection take care of the front stage demands for water and drain required during a show.

Cooking school schedules booking the kitchen are made up 30 to 60 days in advance of show dates, which makes it possible to plan a routing which will provide short jumps as well as to avoid conflicts of two or more schools occurring on the same date.

Consumers Power Co. has found the traveling kitchen show beneficial in stimulating the urge in the housewife's mind to own modern gas devices since it forcefully dramatizes the comfort and convenience of cooking with modern appliances the modern way. According to Mr. Ford, "the stage equipment has replaced those dirty walls, drab drapery backgrounds and poor lighting which prevail in those rooms which we are obliged to work in.

■ ■

Caribbean Cruise Won By Mississippi Dealers

The Mississippi Power and Light Co., Jackson, Miss., recently awarded a free eight-day Caribbean Cruise to the three lucky appliance dealers whose names were drawn from the three highest districts and who earned more than 200 points in the company's "Comfort Cruise" heating campaign, conducted last winter.

Those who made the cruise were James Lenoir Durrett and wife, Henderson Baird Co., Greenwood; Joe L. Newsom and wife, dealer, Tunica, and Edward A. Harwell, president, Harwell Appliance Co., Jackson.

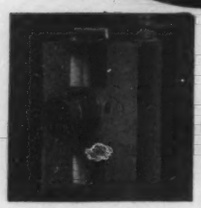
■ ■

Bean Succeeds A. M. Heard as Manchester Gas President

Following the retirement of Arthur M. Heard from the presidency of the Manchester Gas Co., subsidiary of United Gas Improvement Co., Norwin S. Bean, a director and vice-president in the company, was elected president. Mr. Heard's retirement was due to ill health.

Another new appointment in the Manchester Co. is that of H. Ellis Straw who has been elected a director.

PATENTED
Products Protect you from—
cheap imitations
faulty manufacture
inferior materials



Patented

Howle Heat Extractor

Lowers fuel costs; increases basement temperatures from 10° to 20°; gives better, more even heat and warms first floors. It is the most recent advance in scientific home heat-conditioning and fuel economy.

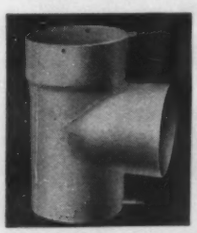
SERVICE AND QUALITY GUARANTEED

Patented

Condensation Eliminator

Is used where space is limited. It prevents the rapid escape of preheated air and increases basement temperatures 5° to 7°. It controls the corrosive action of condensation and protects chimneys.

SERVICE AND QUALITY GUARANTEED



Patented

T-Joint with Drain

Where economy is desired and where available space will not allow installation of Howle Heat Extractor or Condensation Eliminator. Collected condensate is drained off through drain connections and prevented from coming in contact with masonry work at base of chimney.

SERVICE AND QUALITY GUARANTEED

VITROLINER
the permanent Chimney Liner

Canadian Address—184 Horton Street, London, Ontario, Canada

CONDENSATION ENGINEERING CORPORATION
TELEPHONE MONROE 1031
335 South Western Avenue, Chicago

A.G.A. Natural Gas Meeting Will Have Historical Setting in New Orleans

WHEN the Natural Gas Department of the American Gas Association holds its annual convention, May 19-21, in New Orleans, La., natural gas men from all parts of the country will have the opportunity of visiting a city rich in historical background, not only from the point of view of the nation's history, but from that of the gas industry as well.

New Orleans was the fourth city in America to employ gas for commercial and residential purposes. In 1819 James H. Caldwell, an English actor, along with other civic projects, organized the first gas company in New Orleans, many of the original buildings of which are still standing. In vivid contrast to these relics of the past, in less than a day's trip from the city may be seen the famous Monroe natural gas fields, which contribute a major share toward making Louisiana the second largest natural gas producing state in America. At present gas and oil people are looking upon Louisiana as a most favorable state for future reserve.

The Natural Gas Department, of which Robert W. Hendee is chairman, has designed the convention program to bring the natural gas industry up to date in all phases—production, transmission, sales and utilization.

Appealing not only to the men, the convention will include features of direct interest to women. On May 10 Mildred Clark, domestic science expert, will conduct a Home Service luncheon, and the Home Planning Section program will be of particular interest to women.

Convention headquarters will be at the Roosevelt Hotel where S. L. Drumm, chairman of the hotel and housing committee, will be located. Mr. Drumm has announced that all convention delegates should make reservations in advance for accommodations at one of the 12 hotels listed by the A.G.A. Applications for hotel accommodations are now available and delegates are to give three hotel choices, from which the housing committee will endeavor to secure reservations at one of the desired hostelries.

Mississippi Utility Plans "Marching Up Main Street"

"Marching up Main Street in 1938" is the new sales promotion slogan of Mississippi Power and Light Co., Jackson, Miss. The Mississippi utility is keeping pace with the modernization trend which is prevalent on "Main Street." In 1937 restaurant owners spent $76,000,000, almost one-third of which went for gas and electric utilization equipment.

In order to maintain the tendency toward modernization consciousness, the company is studying the potential market for each commercial service in all communities served, placing special sales emphasis where it will be more profitable to the customer and the company.

For coordinating all sales outlets, the commercial sales department of the Mississippi utility is working in close cooperation with electrical and gas equipment dealers. Dealers are being directed in keeping with the Selective Selling Plan now being promoted by the company.

General advertising plans include month by month direct mail advertising which is placed in salesmen's hands to personally sign to send to prospects.

■ ■

Range, Water Heater Sets Offered by Texas Cities Co.

As a means of promoting gas range and gas water heater sales, The Texas Cities Gas Co., Dallas, Texas, has introduced throughout its territory the idea of a matched kitchen set. Automatic water heaters and gas ranges in matched design are offered in six different groups as sets at a price within the reach of the average customer. The kitchen modernization move was well greeted by El Paso housewives, according to company reports. Newspaper advertising, radio programs, truck banners, window displays, and other forms of advertising played an important part in publicizing the idea.

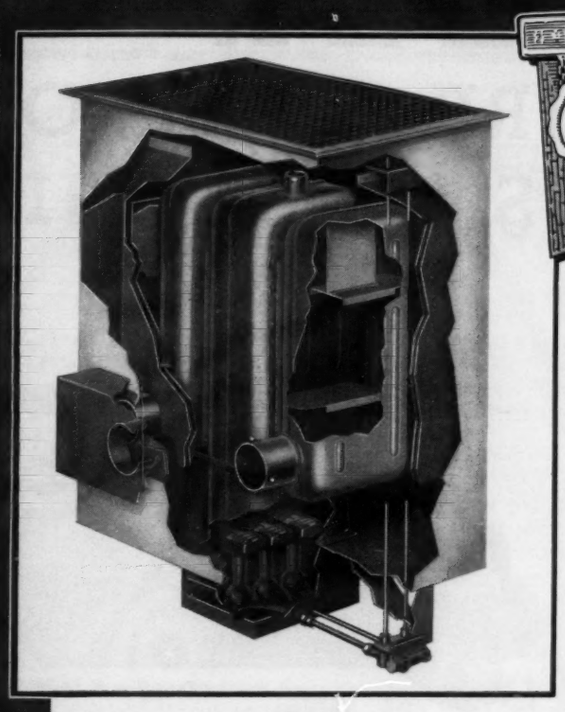
■ ■

"March of Time" Will Again Be Sponsored by Servel, Inc.

George S. Jones, Jr., vice-president and general sales manager of Servel, Inc., has announced that from April 7 to June 30, the company will sponsor the "March of Time" for the second consecutive year. The sponsorship is for the purpose of aiding gas companies in selling Servel Electrolux gas-operated refrigerators.

As last year's radio advertising during the regular spring and summer refrigerator selling season was found to be an important factor in publicizing the refrigerator and dramatizing the gas service, Servel, Inc., decided to include the sponsorship of the "March of Time" as part of its 1938 advertising program

This year the broadcast is timed with the "Make-Every-Minute-Count" campaign, or "Grandfather Clock" contest, in which hundreds of gas utilities throughout the nation will compete for awards. The "March of Time" broadcast consists of a graphic studio presentation of outstanding headline events throughout the world as they happen.



For DISTINGUISHED SERVICE TO GAS

Some one ought to hang a medal on the Payne Floor Furnace. It would be hard to find a heating unit in the entire country that has done so much to sell GAS—and the idea of GAS heating.

The Payne Floor Furnace operates with such thrift that it is used more often—stays lighted longer. It builds the kind of a load you want.

It is so dependable in operation and heats so satisfactorily that it starts people talking about the advantages of GAS heat in general — and, of course, Payneheat in particular.

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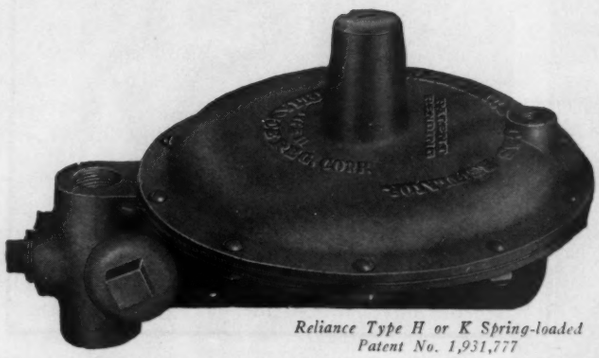
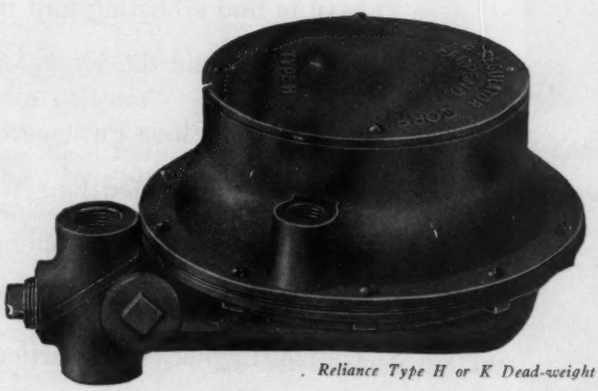
During more than a quarter of a century progressive advancements in design have kept Reliance Regulators in the lead for capacity, precision and positive performance in a wide range of lines and sizes.

SERVICE TYPES "H" and "K" REGULATORS

Reliance Type "H" Regulators are exceptionally economical in service lines where dust troubles exist because it is easily possible to change the valve and blow out the dust without removing the Regulator to the shop for repairs. Specially designed toggle action gives a longer and more powerful thrust on the valve seat and results in lower lock-up pressures. Reliance Type "K" Regulators are similar to Type "H" but are smaller and more compact. Both Types are made in spring and weight loaded designs. Full range of sizes is provided. These Regulators will deliver more gas than any others of the same size. They provide maximum accessibility with minimum maintenance troubles.



Reliance Type H or K Spring-loaded
Patent No. 1,931,777



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- Bulletin No. 40: Type "MR", "MG", "B" and "BK" Liquid Gas Regulators.
- Bulletin No. 41: Type "K" Service Regulators.
- Bulletin No. 42: Type "P" Pounds to Pounds Streamlined Regulators.
- Bulletin No. 43: Type "A" Low Pressure Appliance or House Regulators.
- Bulletin No. 44: Type "H. P. G." Pounds to Pounds Regulators.
- Bulletin No. 45: Type "H.P.C." Compounding Type Pounds to Pounds Regulators.
- Bulletin No. 46: Type "G" Service Regulators.

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RELIANCE REGULATORS

Application of Temperature Measurement To Natural Gas Transmission Lines

By HARRY PROWELL

Chief Engineer

Taylor Instrument Companies*

THE trend in recent years has been towards more accurate measurement of natural gas by the orifice meter. Where large volumes are measured by this method temperature correction is an important factor, and this correction should be applied to the orifice coefficient.

This has been realized by most meter men for many years, but it has only been in recent years that recording thermometers have been used very extensively for this purpose. Before the application of recorders for this purpose the usual procedure was to install a thermometer well in the pipe line and insert an ordinary glass stem thermometer in this well, and then to take a series of readings and average them so as to obtain a mean temperature covering a certain period of time. The temperatures arrived at in this way represented a fair average temperature over a short time, but since these readings were usually taken hourly for, let us say, several days duration, they did not take into consideration seasonal atmospheric temperatures. Some companies, of course, made a survey of these temperatures at different seasons of the year, so naturally their results were more reliable.

When these seasonal observations were taken, a different temperature correction factor was applied, depending upon the time of year.

Let us assume that this method of obtaining these temperatures is satisfactory in some instances, that is, so far as temperature data is concerned. However, there are several disadvantages to this method.

1. It takes a lot of time to observe these temperatures at regular intervals, and there is always the chance that they may be recorded in error on the form sheet provided for this purpose.

2. When glass stem thermometers are used in this manner it is very important to have the well filled with mercury or some other good heat conductor, and some times this is overlooked.

3. A glass stem thermometer is at best hard to read, particularly when in general industrial use, such as the application under discussion. This is further aggravated by the tendency of the pigment in the thermometer etching to wear off, due to corrosion and weather conditions.

4. Where glass stem thermometers are used for this application in large pipe lines, the thermometer should be immersed to approximately half of the pipe diameter. This means that in a 24-in. pipe line, if the thermometer well is installed properly, and a 12-in. thermometer is inserted in the mercury bath, the top of the thermometer will be even with the top of the well. In order to read the thermometer it is necessary to partially remove it from the well, which naturally means an erroneous reading, unless the atmospheric temperature should happen to be exactly the same as the temperature of the gas flowing through the pipe, and as a general rule the atmosphere and gas temperatures are not the same.

An improvement over the above method can be made by the installation of mercury-in-glass industrial thermometers, or dial thermometers. Either of these will eliminate some of the disadvantages of the engraved stem thermometer, but not all, as it is still necessary to take periodic readings.

The mercury-in-glass industrial thermometer, when installed properly does, however, eliminate the necessity of using mercury in the well, as these are available in two types, that is with and without a separable well. When the former is used the bulb of the glass portion of the thermometer is immersed in a mercury bath which is incorporated in the construction of the thermometer, and when the latter is used this same feature is included, but in addition a further protective well is used to prevent corrosion of the bulb chamber of the thermometer. When separable well types of industrial thermometers are used, it is important that the bulb fit tightly in the well, this is best accomplished by using a thermometer with a tapered bulb chamber or stem, and fitted into a separable well having the same characteristics. This assures good metallic contact between the bulb chamber and the well as the union connection of the thermometer is tightened, and consequently a more accurate temperature.

The mercury-in-glass industrial thermometer is easier to read than the ordinary etched stem thermometer, inasmuch as the temperature scale, as a rule, is not etched on the glass tubing, but is engraved on a metal scale, which parallels the glass tube. This permits longer and larger graduations and numerals.

A recent development in thermometer tubing has broadened the field of this type of thermometer considerably, since it is now possible to see the mercury column over a much greater angle of vision than was possible heretofore, and furthermore, due to the unique design of this tubing, it greatly eliminates bore reflection, which in the past has sometimes caused an erroneous reading. The type of tubing referred to in this instance is known under the trade name of Binoc.

This type of thermometer can be supplied with any stem length, which means that a thermometer can be selected so as to have the bulb or sensitive portion properly immersed in the flow of gas and can be read from practically any angle desired, as these are available in all sorts of angles, and since the scale protrudes from the pipe line it is always visible.

Dial thermometers are similar to recording thermometers in their general application, with respect to bulbs, connecting tubing and so forth, except that they do not have a clock and chart.

*Presented before the Southern California Meter Association, in Huntington Park, Calif., September 23, 1937.

SIMPLICITY in design
EFFICIENCY in operation
ECONOMY in maintenance

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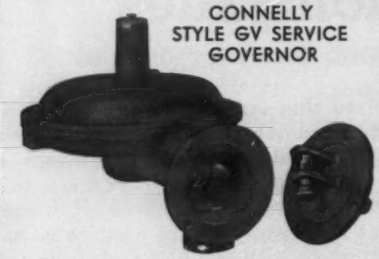
STYLE GV SERVICE
GOVERNOR



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IRON SPONGE & GOVERNOR CO.
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Los Angeles, Calif.

As has been mentioned, recording thermometers are now being used quite extensively in gas line temperature measurement. Let us now look into some of the types that are available for this purpose.

They are mercury, or liquid actuated, vapor tension actuated or gas actuated. Each of these types has a very distinct application in the field of industry, and before any one type is selected for a particular application, a great deal of care should be taken to see that the best instrument for the job in question is selected.

In the gas industry many years ago when a recording thermometer was needed for the line temperature work, it was usually the practice to install the first recording thermometer that could be obtained. Consequently good results were not obtained and in some instances the recorder was condemned. In my estimation a gas actuated recording thermometer should never be used for this application for the following reasons:

1. A gas actuated recorder uses a comparatively large sized bulb, which is further aggravated by the fact that since the bulb is filled with nitrogen gas (a poor heat conductor at best), the system naturally is slow in responding to temperature changes, particularly so when measuring air or gas.

2. Gas filled instruments are not compensated for ambient temperatures, and since a rather restricted range is used in recorders for this application, large errors may be introduced in the true reading on the chart, especially when atmosphere temperatures vary considerably.

Vapor Tension Actuated Recording Thermometers

This type of recorder is used extensively in the petroleum field in general and some installations have been made for temperature measurement in gas lines, with fair results, depending on the particular installation. Since the operation of the vapor tension instrument depends upon the boiling point of a liquid, it is really vapor pressure that actuates the pressure coil in the instrument. This means that we have a very small movement of the pen arm travel on the low portion of the chart, and a comparatively large movement on the high portion per degree of change in temperature. Hence, the non-uniformly graduated chart.

This would not be objectionable if it is desired to use only a certain portion of the chart, but usually it is desired to select a chart which will read accurately throughout the range.

Another disadvantage of the vapor tension recorders is that the accuracy of the instrument is affected by bulb elevation with respect to the instrument case. In other words, a vapor tension instrument can be adjusted to read accurately for a particular bulb elevation, but if the instrument should be taken out of its initial service and put in other service where the bulb elevation is different it must then be adjusted for this new condition.

Mercury Actuated Recording Thermometers

This type of instrument has advantages over the other two types of instruments for this application. They are:

1. Since mercury is really a liquid having a large and uniform co-efficient of expansion, it enables us to use a uniformly graduated chart, which is accurate throughout the range, and further permits the use of a rather wide open chart, thereby getting greater accuracy and ease in reading.

2. Mercury actuated recorders are now available with compensated connecting tubing, thereby eliminating errors due to ambient temperatures. Many years ago this type of connecting tubing was not available and there was some criticism of mercury actu-

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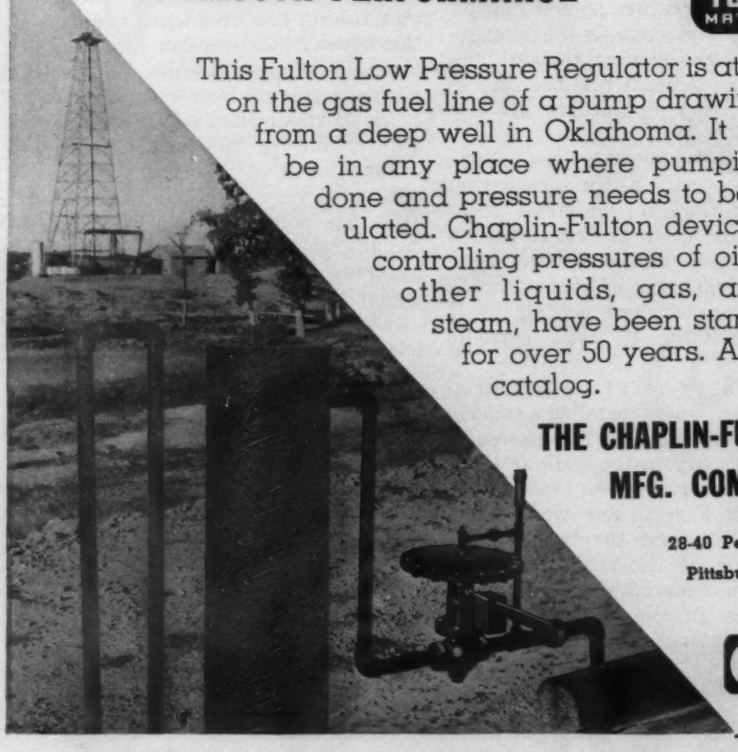

This Fulton Low Pressure Regulator is at work on the gas fuel line of a pump drawing oil from a deep well in Oklahoma. It might be in any place where pumping is done and pressure needs to be regulated. Chaplin-Fulton devices for controlling pressures of oil and other liquids, gas, air, or steam, have been standard for over 50 years. Ask for catalog.

THE CHAPLIN-FULTON MFG. COMPANY

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The Southern California Meter Association's Eleventh Annual Hi-Jinks.

ated instruments as they were influenced by ambient temperatures. This however, is now overcome and it is not uncommon to supply these with more than 100 ft. of connecting tubing.

Until recent years it was common practice to install the bulb of a recording instrument by means of a ¾-in. or larger coupling welded to the pipe. Sometimes these couplings were nearly as long as the bulb or well, of the recording thermometer. An installation of this sort prevents the bulb of the instrument from being in the direct flow of the gas and consequently the recorder does not show the true temperature of the flowing gas. It would have a tendency to record the temperature of the pipe line itself rather than the gas. This is especially true when installed in larger pipe lines.

Another important point on bulb installation, when an instrument is used with a separable well, is to be sure that the bulb fits the well properly, so as to assure good metallic contact between bulb and well. Otherwise, there is an air space between the bulb and the inside wall of the well, and the recorder will not respond to temperature changes as readily.

As pointed out above under the subject of etched stem thermometers and industrial thermometer installations, regarding the importance of proper bulb immersion, those same facts hold with respect to recording thermometer installations.

The reliability of a recording thermometer is largely dependent upon the proper installation of the bulb. Two of these important factors were just pointed out.

When these installations are made in large pipe lines a well of sufficient length should be used so as to permit the sensitive portion or bulb of the recorder to be inserted in the bottom of the well.

It is preferable to use a bulb of comparatively small size which fits tightly into the bottom of the well, and to have this bulb so constructed that the connecting tubing when welded to the bulb, is extended to the union connection at the top of the well, rather than to have the bulb rigid to the union connection.

One manufacturer carries this a little further and inserts a corrugated aluminum sleeve between the bulb and the inside wall of the well, thus assuring good contact between the bulb and the well, and the speed of response thereby gained is excellent. This type of construction eliminates to a large extent the tendency of the recorder to show the temperature of the pipe line itself, instead of the temperature of the gas, as it lessens the heat transfer from the pipe to the bulb and vice versa.

It should be noted that this type of instrument construction together with the proper installation of bulb and well as outlined, has made possible more accurate recording temperature measurement of flowing gas.

These may be summed up:

1. Better understanding of instrumentation.
2. Selection of proper type of instrument for a particular application.
3. Availability of instruments not affected by ambient temperatures.
4. Improvement in bulb and well construction designed to give quicker response to temperature changes.
5. Proper and correct bulb and well installation.
6. Co-operation of industry and the instrument manufacturers.

S.C.M.A. Committee Reports On Orifice Coefficient Data

THE regular monthly meeting of the Southern California Meter Association was held Thursday, March 24, at the Van Matre Inn, Huntington Park, Calif. J. B. Taylor, president of the Association, conducted the meeting.

J. B. TAYLOR

A feature of the program was an address by C. T. Reid, assistant chief draftsman of the Douglas Aircraft Co., Inc., who offered highlights on the design, construction, and materials used in manufacturing the 42 passenger, four-motor transport planes now being constructed by his company. Second speaker was President Taylor who read the report of the Committee on standardizing the use of the new orifice coefficient data (C.N.G.A. —TS-353 and A.G.A., Report No. 2). Discussion followed the reading of this report.

The report on "Positive Displacement Meters for Liquids" which was published in the Measurement and Control Section of *GAS* in March was first presented before the Southern California Meter Association at its meeting on January 27, 1938.

The Association held no regular meeting in February, concentrating its activities on the 11th Annual Hi Jinks. A photograph of the group attending this affair appears on this page.

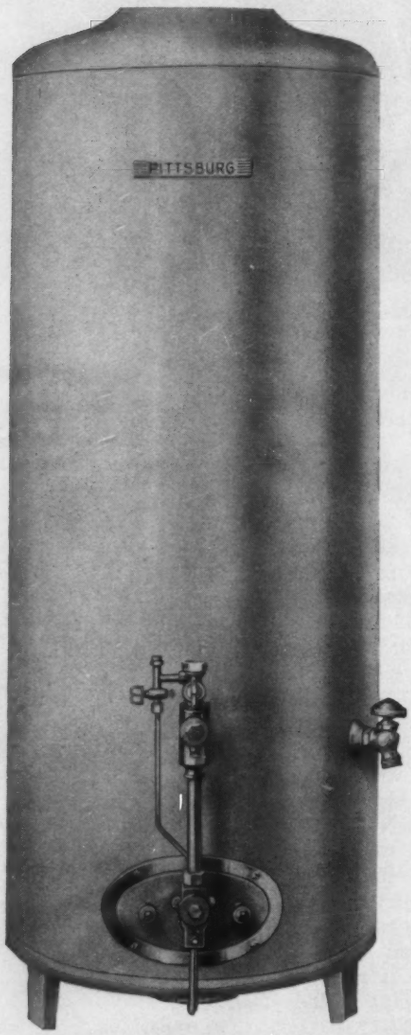
■ ■

Cities Service Builds 8-in. Line to Electric Plant

Cities Service Gas Co. has completed construction of an 8-in. gas pipe line from the Oklahoma City 20-in. main to the Harrah electric plant of Oklahoma Gas & Electric Co.

Cities Service has added one 170-hp. twin Cooper engine at the Wellington compressor station near Wellington, Kan., giving the station a total of 490 hp.

A Heater *Designed Exclusively* For All Liquefied Petroleum Gases



Pittsburg's Liquid Petroleum Heater is a completely automatic, fast recovery type, gas storage water heater, in capacities of 20 and 30 gallons. Designed with engineering features for high efficiency and economical operation. It will give superior service where demands are heavy and hot water must be always ready with no waiting. Guaranteed for long life, modern in style and finished in lasting enamel.

SPECIAL FEATURES

The burner, specially developed for these gases, is made in one piece with raised ports. It has a short venturi throat with adjustable intake and a fixed orifice.

The Pilot is of the bunsen type—Bi-Metallic—which will automatically shut off all gas to both pilot and main burner in case the pilot light should for any reason be extinguished.

The Thermostat has a positive snap action type. Built specially for Liquefied Petroleum Gas.

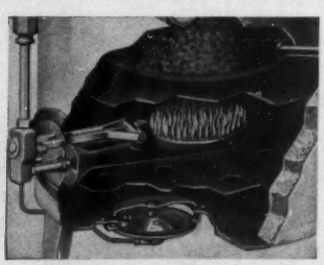
The Airtrol—an Exclusive Pittsburg feature—decreases standby loss insuring maximum economy. An Aeration plate and heat shield further increases efficiency by controlling the distribution of secondary air in the combustion chamber.

The extra heavy galvanized tank is of a special design made in 2 sizes—20 and 30 gallon capacities.

The Insulation is Rock Wool and Wyolite combination with 2″ on the sidewall and 4″ on the head. All sheet metal parts are "Rust-Resist" treated assuring longer life against any corrosion.

The Streamline design has an eye appeal but the exclusive features and performance has an economy appeal that is hard to resist. A Cut-a-way view shows the completely concealed simplified mechanism, burner, airtrol and tank insulation.

The heater is supplied in our standard colors—and has a very splendid eye appeal. Recovery capacities are far beyond any heater now used for Liquid Petroleum Gas. The 20 Gallon heater has a 25,000 B.t.u. input with a 35 gallon per hour replacement A.G.A. rating. The 30 Gallon heater has a 30,000 B.t.u. input with a 42 gallon per hour replacement A.F.A. rating.



The Airtrol stops all circulation of cold air through the heater when the main burner is thermostatically shut off.

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BUTANE-PROPANE NEWS

Liquefied Petroleum Gas Association Holds Annual Meeting in St. Louis

By CRAIG ESPY
Assistant Publisher, G A S

AT THE Seventh Annual Meeting of the Liquefied Petroleum Gas Association, Inc., held at the New Jefferson Hotel in St. Louis, March 21-22, W. F. Verkamp, president of the association, pointed to the change in name of the association from the National Bottled Gas Association to the present corporate name and the extension of the activites of the organization to include all branches of the liquefied petroleum gas industry as one of the most important developments taking place in the history of the organization which was officially launched in 1930. This is the first meeting to be held since the group became in September 1937, the Liquefied Petroleum Gas Association, Inc.

Other important developments of the year recalled by Mr. Verkamp were the re-drafting of the Constitution and By-Laws allowing for sectional representation on the Executive Board, the revision of assessments and the granting of active memberships to companies engaged in marketing allied products, this latter leading to an enrollment of approximately 36 new member companies. He also spoke of the ground-work done in 1935-1936, for the organization of Eastern, Pacific, Midwestern and Southwestern sectional groups, leading to the perfecting of such organizations in the Midwest and Southwest in 1937. His talk also gave a brief history of the association and its activities since inception.

F. R. Fetherston, secretary and treasurer of the organization, in addition to presenting the annual treasurer's report, showed how the association had lived up to the aims of the Constitution calling for the promotion and development of the industry and the coordination of its activities to the end of serving the best interests of the public, increasing the effectiveness of gas service and promoting closer relations and co-operation between the branches of the industry.

L. H. Spiner, advertising manager, Shell Petroleum Corp., spoke at the luncheon held prior to the annual business meeting, which was preceded by general registration of delegates.

The first day closed with separate meetings of the Midwest section, B. D. Geroy, chairman; G. W. Bach, secretary, and the Southwest section, H. C. Pitman, chairman; M. J. La Due, secretary. A meeting of the Board of Directors of the national organization closed the program.

Directors elected in the opening session were:

Class A—G. W. Bach, Skelly Oil Co., Kansas City, Mo.; F. B. Boice, Shell Petroleum Co., St. Louis, Mo.; H. E. Thomas, Phillips Petroleum Co., Detroit, Mich.; J. E. Balsley, Standard Oil Co. of California, San Francisco, Calif.; H. S. Bunn, Carbide & Carbon Chemicals Corp., New York City, N. Y.; P. H. Zook, Sloan & Zook Co., Kane, Pa.

Class B (above ground systems)—W. F. Verkamp, Verkamp Corp., Cincinnati, Ohio; J. W. Martin, Lone Star Gas Co., Dallas, Texas; A. N. Kerr, Imperial Gas Co., Los Angeles, Calif.

Class B (below ground systems)—G. A. Burrell, Atlantic States Gas Co., New York, N. Y.; M. E. McKay, Hydrogas Co., San Antonio, Texas; H. W. Richdale, Vapyre Corp., Brewster, N. Y.

Class C—R. P. Dieckelman, Pressed Steel Tank Co., Milwaukee, Wis.

Class D—L. J. White, Southern Steel Co., San Antonio, Texas.

Class E—E. L. Mills, Bastian Blessing Co., Chicago, Ill.

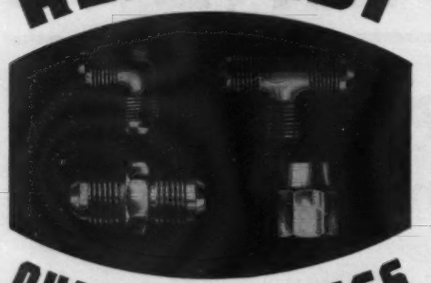
Class F—George Jones, Servel, Inc., Evansville, Ind.

The Board later announced the re-election of association officers: W. F. Verkamp, president; E. L. Mills, first vice-president; M. E. McKay, second vice-president, and F. R. Fetherston, secretary and treasurer.

Board discussions included ways and means for giving closer coopera-

A luncheon session at the 7th Annual Meeting of the Liquefied Petroleum Gas Association in St. Louis.

KEROTEST



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Kerotest Fittings of heavy design are the work of master craftsmen and comprise a complete line of S.A.E. flare crosses, tees, elbows, unions, and nuts for your copper tube installations of propane gas.

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tion to members of the industry faced with special legislative measures. One outgrowth of the discussion will probably be the appointment of a special committee to deal with problems of this nature. It also was decided as impractical to establish definite boundaries for geographical divisions of the industry, but instead to leave it to the individual member to join the sectional group preferred.

The Southwestern division, recently organized, adopted the name Southern division, making it more representative of the area which it expects and hopes to serve. It also decided to hold its first annual meeting in September in Little Rock, Ark. B. T. Harris and his Hydro-Gas Co. organization will be host at the meeting. A committee was appointed to draft by-laws for the organization that will conform to requirements of the National organization. H. C. Pitman is chairman of the division and M. J. LaDue, secretary.

K. R. D. Wolfe, Fisher Governor Co. was elected chairman of the Midwest division succeeding B. D. Geroy who has held the office since the organization of the division. H. W. Sweet was elected vice chairman and K. W. Rugh, secretary. A membership committee, consisting of F. D. Ruesser, G. L. Brennan and I. L. Tucker, was appointed. The Fall meeting of the group will be held in Chicago. B. D. Geroy was appointed chairman of the Program Committee for this meeting.

Three papers given before the Tuesday morning session by A. N. Kerr, Imperial Gas Co., A. B. Mosher, Carbide & Carbon Chemicals Corp., and R. W. Thomas, Phillips Petroleum Co., traced the early history of the industry, the progress and development from 1920—1938 and the industry's future. R. W. Thomas' paper covering the latter subject will be published in an early issue of *G A S*.

George Jones, Servel, Inc., in talking upon sales showed how the interest of his organization and those of the liquefied petroleum gas industry were identical. He said the way to make a success of any business is to concentrate on selling. It is his opinion that the periods of depression were good periods for specialty selling because people had more idle money in the bank at these times.

R. L. Edwards next traced the development of the Hydro-Gas System pointing out the characteristics of the system from an illustrated chart. He replaced L. J. White of Southern Steel Co. who was to speak on "Underground Systems for Utilization of Liquefied Petroleum Gas."

J. W. Martin, Stargas Division of Lone Star Gas Corp., Dallas, showed a moving picture illustrating the essential steps in serving New Stargas, a service provided by Lone Star Gas Co. to supplement its pipe line services.

Jacob M. Lashly, Attorney, was speaker at the luncheon meeting. During the afternoon sessions J. I. Banash, consulting engineer, Chicago, Ill., spoke on accident prevention and its relation to the industry. Representatives of the Barrett Co. and Republic Steel Corp. discussed the problems of corrosion. Other speakers of the afternoon included W. C. Buttner, Bastian-Blessing Co., on "Excess Flow Check Valves;" J. K. Koeneman, Southwest Gas Corp., on "Servicing Equipment in Customers' Homes." A general discussion forum closed the afternoon meetings.

H. W. Richdale presided at the morning sessions of the association and Frank B. Boice was chairman at the afternoon meeting.

Registration at the Seventh Annual Liquefied Petroleum Gas Convention totaled 110 delegates, which number almost approximates the number of companies represented. Delegates came from states as distant as New York and California.

HANDBOOK

BUTANE
PROPANE
GASES

SECOND EDITION
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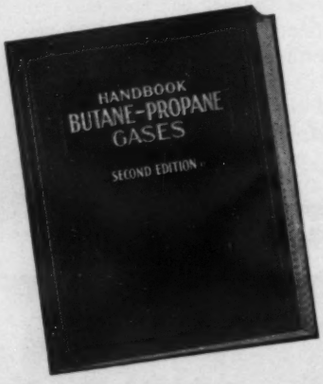

CONTENTS: Use in internal combustion engines: Design & Installation of Storage: Supply from Petroleum Refineries: Engineering Data on the Lower Olefins: Domestic Appliance Testing and Utilization: Economical Comparisons with Coal, Oil, Electricity, Producer Gas, Manufactured Gas: Town Plants: Manufacture from Natural Gas: Special Uses: Volume Correction Factors: Supplements & Revisions: Transportation: Use with other Gases: Analysis & Testing: Properties of Mixtures: Bottled Gas Distribution: Bibliography: Central Plant Directory: Catalogue Section.

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810 S. Spring St.
Los Angeles, Calif.

Hydro-Gas Co. Makes New Group Installations

THE Hydro-Gas Co., of West Florida, Inc., Pensacola, Fla., has completed several group installations, one which supplies gas for 22 homes, a meter having been installed in each home. A monthly billing system is used by the company.

Donald Stow is president and Robert W. A. Robinson, secretary-treasurer of this corporation which distributes Hydro-Gas in 13 counties adjacent to Pensacola. At Brewton, Ala., the company has leased a bulk storage installation, which was originally intended to serve a butane-air system in that city. Gas also is sold to Brewton for distribution in the city mains.

By the close of the year, Messrs. Stow and Robinson expect to increase service to 1000 meters, in addition to many customers to whom fuel is delivered on a price per gallon basis. To date 500 space heaters and a number of other types of gas heating units have been installed.

For demonstrating Hydro-Gas service, a fully equipped house trailer travels to such gulf coastal cities as Port St. Joe and Panama City.

■ ■

Skelgas Co. Erects New Plant in Spencer, Iowa

The Skelgas Co., Kansas City, Mo., recently announced that construction is getting under way for the erection of a bottled gas plant in Spencer, Iowa. Designed to serve a territory from 75 to 100 miles in radius from Spencer, the new plant will service Skelgas dealers throughout northwest Iowa, parts of north central Iowa, southern Minnesota, and in eastern South Dakota. Bottled gas for this region has previously come from Des Moines.

The completed Skelgas plant will consist of two steel buildings, one for a pump house and bottling building and the other for warehouse purposes. Loading docks and a large storage tank will also be built.

A. F. Busse will act as manager of the new plant, which will be the sixth bottling center established by Skelgas.

■ ■

Muncie, Ind., Has First Air-Conditioning Meeting

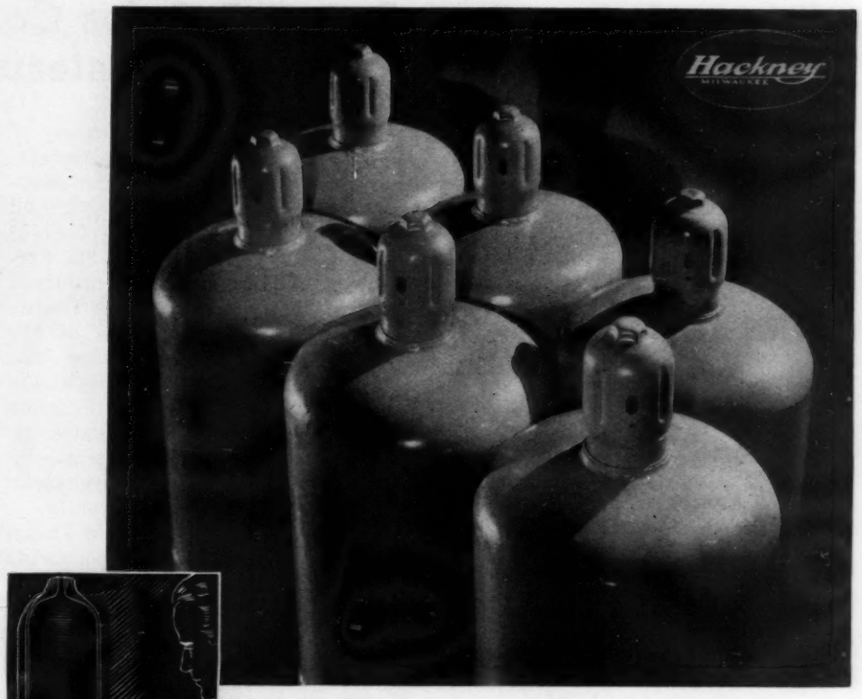
The Central Indiana Gas Co. and the Knapp Supply Co. of Muncie recently co-sponsored an air-conditioning meeting at Muncie, one of the first of its kind ever held in that territory. James C. Patterson, Carrier Corporation of Syracuse, N. Y., addressed the group.

The session was attended by 110 industrial engineers, factory managers, doctors, hotel, restaurant, and theatre operators, and others interested in freedom from climatic conditions.

■ ■

Butane Gas Products Co. Plans New Location

The Butane Gas Products Co., manufacturers of gas and gas appliances, will have a new location in Van Nuys, Calif., when the Kennedy building, which the company recently leased, is completed. The building's three store rooms will be used by the Butane Co. for office, display room, and work shop.



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The gas industry has, for many years, recognized the value of Hackney dependability. In every detail of construction Hackney cylinders are built for economy and service. The uniformity of wall thickness of Hackney cylinders provides uniform strength at all points. Their uniform capacity and weight assure economy and satisfactory performance.

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Furnished in combinations suitable for single and multiple set-ups, high and low pressure. Features: (1) Sections resist displacement when installed and are securely locked together by concealed rods. (2) Boxes may be lengthened without removal. (3) Knockouts are provided for pipe connections.

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P. C. G. A. Sales Conference Delegates Attend Western Metal Congress

THE Spring Sales Conference of the Pacific Coast Gas Association, sponsored jointly by the Association's Sales and Advertising and Manufacturers Sections, was held in Los Angeles, March 24 and 25. Presiding over the program meetings were Norbert O. Fratt of the Seattle Gas Co. and C. R. Graham of the James Graham Manufacturing Co., chairmen respectively of the Sales and Advertising and the Manufacturers groups. On both days delegates attended sessions and visited the gas industry exhibit at the Western Metal Congress, which met concurrently.

Separate meetings were held Thursday morning by the two sponsoring Sections. Speaker before the domestic sales meeting was O. R. Doerr of the Pacific Gas and Electric Co., his subject being, "What Salesmen Should Know." The inudstrial sales members heard Otto Ketelsen of the San Diego Consolidated Gas and Electric Co., who spoke on "A New Approach to the Commercial Cooking Load."

The meeting of the domestic sales members was continued in the afternoon, but the industria alnd commercial members adjourned to the Western Metal Congress. Final meetings of the two groups took place Friday morning. The subject of domestic heating and air conditioning was discussed at the domestic meeting, while L. P. Stoker, Precision Control Co., an Wd. W. German, Montana Power Co., dealt with the subject, "Draft and Other Control Equipment," before the commercial and industrial group.

Hal Elias of Metro-Goldwyn-Mayer studios, was the speaker before the Thursday Luncheon, his remarks dealing with the two Pete Smith technicolor shorts, "Penny's Party," and the Academy Award Winner, "Penny Wisdom." Both short subjects prominently feature the use of gas appliances. During the Friday luncheon motion pictures of gas industry activities during the recent southern California flood were shown.

■ ■

Program Set for P.C.G.A. Spring Conference

(Continued from Page 26)

ering Odds and Ends in Hollywood."

FRIDAY AFTERNOON

GENERAL SESSION OF TECHNICAL SECTION

Auditorium
2:00 p. m.—5:00 p. m.

1. Reports of major committee chairmen.
2. Report of New Research Committee (Guy Corfield, chairman).
3. "Geophysical Prospecting for Oil and Gas Reserves" by Dr. J. J. Jakosky, International Geophysics, Inc.
4. "Maintaining Gas Service Under Flood Conditions" by E. H. McDermott and F. A. Hough.
5. "Installing a Submarine Gas Main," C. P. de Jonge (Repeated by request).
6. Closing Remarks, Arthur B. Allyne, general chairman.

■ ■

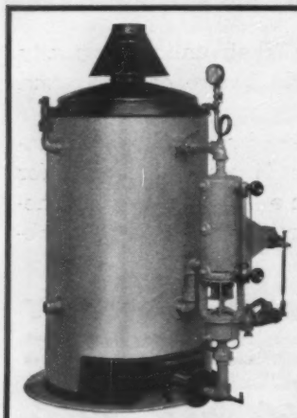
Automatic Gas Co. Serves Liquefied Fuel in Selma, Ala.

Recently organized at Selma, Ala., the Automatic Gas Corp., is engaged in sale and distribution of underground liquefied gas systems and gas appliances. This company, of which Cecil Gardner is president and P. C. De Bardeleben is secretary-treasurer and manager, is operating in 21 counties adjacent to Selma, handling Hydro-Gas Systems.

■ ■

Phillips Petroleum Orders New Propane Tank Cars

The Phillips Petroleum Co., Bartlesville, Okla., recently ordered 10 propane tank cars from General American Transportation Corp., Chicago, Ill.



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ASME Code for 100 lbs. S.W.P., also for higher pressures.
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Two million dollars to be saved annually by P. G. and E. customers as a result of gas rate reductions is **big news!** It's going to give added impetus to the sale of gas furnaces, gas room heaters, boilers and all other types of gas heating equipment. Three of our advertisements during April will be devoted to merchandising the rate-cut, tying it up with the story of clean, carefree gas heating. Each advertisement will be promotional in character, inviting dealers to publish their tie-in advertisements along side. Advance proofs should be in your hands on or about April 1. We suggest that you study them and plan your tie-ins immediately. Strike while the iron's hot.

P·G·and E·

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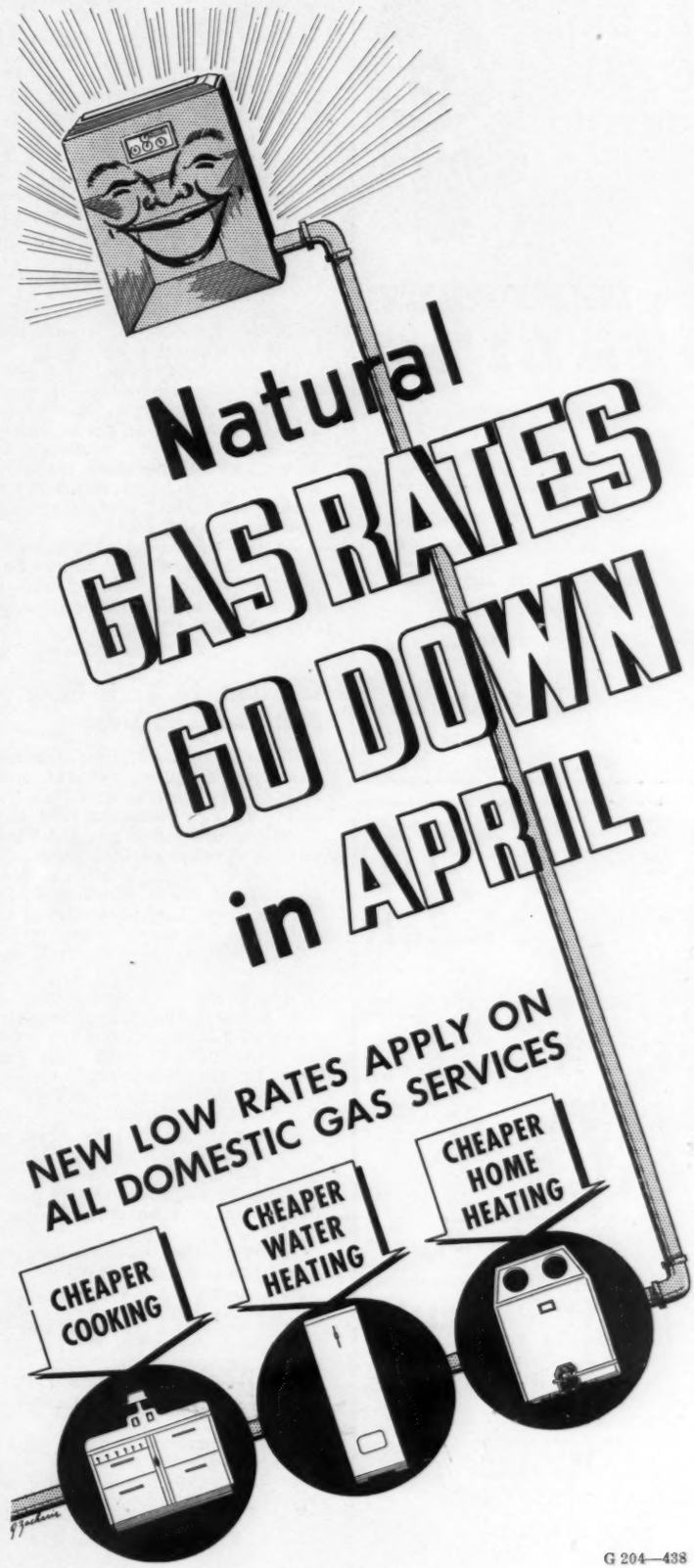
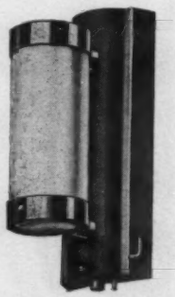


MODERN
GAS
LIGHTING



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Petroleum Exposition To Be Held in Tulsa, May 14-21

FINAL preparations for the 10th International Petroleum Exposition, with W. G. Skelly, as president, are now under way. The exposition, which will feature all phases of modern development in the oil industry, will be held May 14 to May 21, in the new Hall of Science in Tulsa, Okla.

One of the outstanding exhibits will be the scientific and technical display, for which Dr. Gustav Egloff, chairman of the scientific and technicolor committee and director of research for Universal Oil Products Co. and the directors of the oil show, has been largely responsible. Dr. Egloff has made it possible to procure the main part of the scientific display from the Museum of Science and Industry in Chicago.

On the south east side of the Hall of Science the transportation display will be shown. Included in this exhibit wil be a static model of an ocean, rail and pipe line terminal and a sectioned tank car, as well as an operating model of a pipe line construction job. Exhibits on helium, carbon black, and a pumping station will also be shown here.

At the south end of the building will be the refining division where butane and propane will be displayed with polymerization, foamite demonstration, catalysis, etc. exhibits.

■ ■

Goshen, N. Y., Is Now Natural Gas User

Since January 5, 1938, Goshen, N. Y., has been supplied natural gas by the New York Electric and Gas Corp, Liberty, N. Y. Plans for the changeover from manufactured gas were under way during October of last year.

Natural gas for Goshen is procured by New York State Electric & Gas from the Rockland Light and Power Co. which indirectly draws its supply from the Wayne Field, N. Y., and the Tioga Field, Pa.

To complete the changeover, construction work included approximately eight miles of 3-in. high pressure transmission line. About 3.8 miles of the line were built by the New York corporation in its franchise territory and are available for retail distribution outside of Goshen. The remainder of the line was constructed by the Rockland Co. to a point near Middletown. No compressor stations were required as the gas pressure in the main transmission line is adequate.

Although the natural gas was made available at a late date, 18 househeating installations were sold in a community with only 420 meters.

■ ■

Oklahoma Utilities Annual Convention Held In March

The annual convention of the Oklahoma Utilities Association was held at the Biltmore Hotel, Oklahoma City, March 21 and 22. Association president, J. Y. Wheeler, Community Natural Gas Co., addressed the opening session.

Addresses dealing with natural gas and allied subjects included in the convention program were: "Federal Taxation and Competition," by Roy C. Coffey, general attorney Lone Star Gas System, Dallas, Texas; "Organized Advertising and Sales Campaigns," Frank C. Smith, president, Houston Natural Gas Co., Houston, Texas; "The Fourteenth Annual Gas Meter School," Gilbert Estill, Oklahoma Natural Gas Co., Tulsa, Okla.; "The Value of the Oklahoma Utilities Association," C. A. Breitung, Southwest Natural Gas Co., Ada, Okla.; "Modern Trend in Engineering Education," Dr. W. H. Carson, University of Oklahoma, Norman, Okla.

George Ade Davis, vice-president, Oklahoma Gas and Electric Co., presided at the dinner held on March 21. Principal address of the evening was delivered by James G. Blaine, assistant general attorney, M. K. & T. Railroad, St. Louis, Mo.

■ ■

Derwent Presides at Gas Range Division Meeting

W. E. Derwent, chairman of the A.G.A.E.M. domestic gas range division and vice-president of the George D. Roper Corp., Rockford, Ill., presided at the special February 28 meeting of the range division held at the Waldorf-Astoria, New York City. Plans for the nationwide promotional campaign aimed at increasing the sale of gas ranges was the chief subject of discussion at the gathering.

W. E. DERWENT

Interest in the sales promotion plans has been stimulated by the recent passage of the Federal Housing Act, C. W. Berghorn, executive director of the Association of Gas Appliance and Equipment Manufacturers, recently reported.

■ ■

Missouri Public Utilities To Hold Convention

The Missouri Association of Public Utilities will conduct its annual state convention April 20-22 at the Hotel Jefferson, St. Louis, Mo. Chester C. Smith, Association president, will preside at the business session and at the luncheon, April 21, and banquet, April 22.

The convention will open with a safety meeting and round table discussion of accident prevention. On April 22 the annual Open Forum on utility subjects will be held.

Convention speakers will include: A. A. Nichoson, manager of personnel, The Texas Co.; W. C. Beckjord, vice-president, American Gas Association and general manager, Columbia Gas and Electric Corp.; J. B. Wilson, president, Laclede Gas Light Co.; and B. F. Dickmann, Mayor of St. Louis, Mo.

■ ■

Roy Holt is Service Head In Burkburnett, Texas

Roy Holt, formerly of Vernon, Texas, is the new service manager for the United Gas Corp. in the company's Burkburnett, Texas, office. Mr. Holt succeeded Robert Dunn who resigned, after 10 years association with United Gas, to join the Gulf Co.

1938
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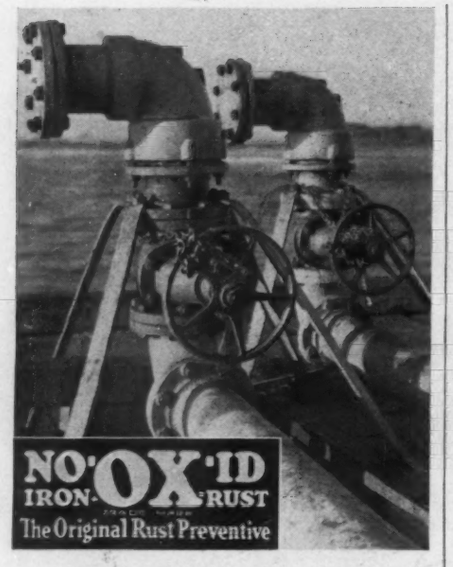

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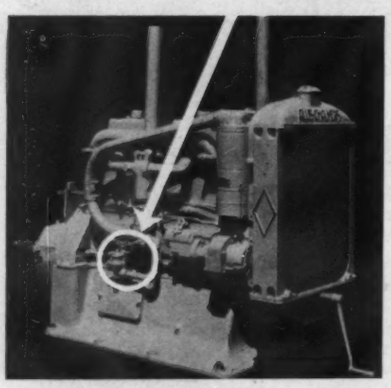

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Gas Service Meets Test As Flood Strikes California

(Continued from Page 20)

Eastern division headquarters at San Bernardino and Los Angeles ceased during Wednesday afternoon, and all orders and information had to be handled by telegraph, which required from two to four hours in transmittal. However, it was learned at headquarters that the main lines were giving before the force of rising waters, and by 6:00 o'clock in the evening both San Bernardino and the adjacent town of Redlands were out of gas service. Mains east to Palm Springs and south to Hemet were found broken, and the small communities supplied by these lines soon exhausted the holder supply.

In the meantime trouble began to develop south of Huntington Beach where the Santa Ana River had formed a great lake in the lowlands back of the state highway (Map, XVII). Here the 12-in. Southern Counties line supplying San Diego was being undermined. This line actually held until 8:45 Thursday night, when it was cut out with a great section of the highway at a point a few miles south of Huntington Beach. San Diego Consolidated Gas and Electric Co. picked up the load in their diesel oil gas generating plant. During the emergency the San Diego Company made about 24,000 M c.f. of 1050 B.t.u. diesel oil gas. Only industrial shut-off customers were affected by the shortage.

By midnight Wednesday night only one of the six lines coming from San Joaquin Valley and from the Santa Barbara-Ventura district was still in commission, and the two standby gas manufacturing plants in Los Angeles were ordered to make gas as soon as they could be put into operation.

Although the rain had ceased by Thursday morning, the danger was by no means over. Flood control dams in the mountains had been filled to capacity and were spilling large volumes of the water into the streams. In the Tujunga wash north of Los Angeles, two important transmission lines were endangered by the large amount of water continuing to flow down the stream. If these lines had gone out, the operating companies would have been dependent entirely upon natural gas supplies in the Los Angeles Basin, and upon the supplies from the three diesel oil manufacturing plants.

Later in the day one of these lines, the 22-in. supplying North Hollywood, Beverly Hills, Santa Monica, West

Los Angeles and Hollywood (Map, X) developed a leak which necessitated a rerouting of the gas until the pipe could be repaired. Holders at Hollywood and Slauson stations maintained the load until the line could be put in commission early in the evening.

Early Thursday morning San Bernardino requested help, and 42 service men from the Los Angeles distribution department, under the leadership of Mike Johnstone, set out to try to get through. Some 20 miles from their destination they were forced to abandon their cars and had to hike the rest of the way through washes and over railroad bridges. They arrived in San Bernardino about noon.

By Friday morning it became apparent that the immediate danger was over, and a general survey of the damage was begun with a view to rehabilitation. San Bernardino, Corona, Elsinore, Redlands, Hemet, San Jacinto, Beaumont, Banning and Palm Springs were all out of gas.

Fully 28 major breaks had occurred over the system. Indeed, all major pipe lines bringing gas into the Los Angeles Basin were broken at one or more points, and only one of them was in condition to transport gas. This was the 22-in. Southern California Gas Co. line bringing gas from San Joaquin Valley. The San Diego supply line was out, but the small communities in the Southern Counties Gas system south of the break were still being supplied. Fillmore and Piru had experienced a temporary outage, and there were isolated outages at scattered points throughout the systems of the two main operating companies.

However, the industry could congatulate itself on the fact that it had managed to hold service to the major portion of its customers. The only outage of any great magnitude was that in Southern California's Eastern division, which comprised about 29,000 meters and represented less than 5 per cent of the total users in Southern California. Final figures show that only 35,000 out of a total of 930,000 customers suffered gas shortage.

Rehabilitation was begun immediately. The Eastern division, most severly affected area, had breaks in 31 or more widely separate points. Subsidence of flood waters in the Santa Ana River and Lyttle Creek in San Bernardino and Riverside counties enabled temporary repairs to be completed by six o'clock Friday afternoon. In San Bernardino proper practically the entire male force of the Southern California Gas Co., in-

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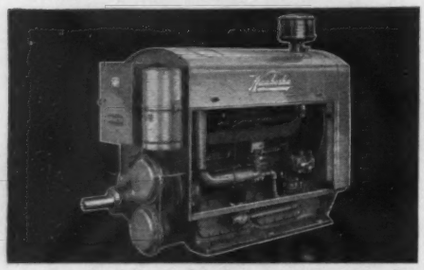

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cluding service men, meter readers, bookkeepers and salesmen, had turned to, and had accomplished the huge task of turning off the town's 14,000 gas meters. Customers were informed by commercial radio and by newspaper notice that the gas company was ready to resume service, provided access could be gained to homes. With the temporary restoration of main pipe lines, the forces of the gas company once more went into the field, and by midnight Friday night had turned on 13,000 of the town's 14,000 meters.

In the meantime telephonic communication had been established between the Eastern division and Los Angeles headquarters. The connection was made through a long distance hook-up which covered five states and followed a circuitous route 2400 miles long through San Francisco, Salt Lake City, Denver and Phoenix.

A large force of service men and trained gas men were dispatched to assist in restoring service to the rest of that division. By working almost without sleep and rest, these men succeeded in restoring service to Redlands by midnight Saturday night, and to the other smaller communities in the Eastern division by Sunday night. Hospitals and hotels already were on butane service and were cut over to natural gas as rapidly as possible. Except where houses had been washed away, evacuated, or were unoccupied at this time of year, everyone in the division had gas by nightfall, March 6.

The task of making repairs to the San Diego line was impeded by the fact that the Santa Ana River, draining a very large territory, remained quite high at the point where the break occurred. Similarly the restoration of the Industrial Fuel Supply 15-in. crossing at Saticoy was held up by high water. Here repeated attempts were made to get a line across by which a cable might be pulled over. The water was too turbulent for boats to be used, and the job was finally accomplished by the effort of a young Industrial Fuel Supply employee, Joseph E. Hughes, who swam the river a number of times. Southern California Gas Co.'s 12-in. gas line at Camulos, east of Piru, was so badly damaged that it was considered wise to use pipe salvaged from it to restore the Southern Counties line, which was broken at the same point.

Wednesday morning, March 9, saw two lines from Ventura and two lines from San Joaquin Valley in service. A storm Friday night and Saturday caused high water in the Santa Clara River and Castaic Creek. As a result, the Saticoy temporary line was torn out and the Southern Fuel 26-in. line return to service was delayed. The new Saticoy line was in service on March 16, and the Southern Fuel 26-in. on the same day. Repairs from now on will be of permanent nature and will extend over several months.

The Southern California gas industry was fortunate indeed that the damage to pipe lines and property was not greater. Those in the industry can be proud that only a very small percentage of total essential customers were out of service.

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GAS VALVE SERIES 500
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Northern California

Natural Gas Division of Pacific Gas and Electric Company kept its collective fingers crossed effectively during the weeks of downpour. In the Kettleman area, eight miles north of Kettleman Hills, Stanpac and Bay main lines, buried two feet under Arroyo Pasajero creek bed were left hanging high when the soil was washed away in the rushing torrents. Work done last summer in reinforcing every welded joint in the line at this point is credited with saving the line. Trees and debris crashing against the exposed pipes with great force failed to tear them out or disable them for

service. Between storms, after the parallel lines were exposed, they were tied together and braced for mutual strengthening.

As a precautionary measure, a spare pipe line was laid across the creek on the surface of the ground several feet above the normal water level. At the top of the flood the creek overflowed its banks and water was rushing over the spare pipe lying on top of the ground.

To avert the disaster of threatened slides in the mountainous sections of the natural gas territory, some of the lines were tied and anchored by cables.

In the San Francisco Bay region, the territory served by the Pacific Gas and Electric Co., greatest damage occurred not to the gas distribution and transmission systems, but to the company's electrical facilities. As reported by Robert R. Gros of the company's publicity department, the difficulties encountered on the gas service mains of the company were minor and routine.

Seriously affected, however, by the wind storms, torrential rains and abnormal snow falls that occurred during February and March were the company's 6000 miles of electrical distribution lines and its 30,000 miles of electrical distribution wires. Altogether more than 2250 miles of transmission and 5000 miles of distribution facilities were out of commission during the succession of storms which followed the heavy gale of February 9. Service throughout the system was restored within a 10-day period.

■ ■

C. S. Pearce Is Secretary For Porcelain Enamel

Charles S. Pearce has been appointed secretary of the Porcelain Enamel Institute, Chicago, Ill., according to a recent announcement by Frank E. Hodek, Jr., institute president. Mr. Pearce succeeds George P. MacKnight, former secretary.

Since the fall of 1935 Mr. Pearce has acted as assistant director of Personnel for the Farm Security Administration, which position he left to assume his new duties.

Previous to his work in the personnel field, Mr. Pearce headed the enameling operations of the Davidson Enamel Co., Clyde, Ohio.

■ ■

United Natural Gas Co. Buys 54 Acres in Pa.

The purchase by the United Natural Gas Co., Oil City, Pa., of 54 acres of land in Eldred township, Jefferson county, Pa., was recently approved by Judge Robert M. Gibson in federal court in Pittsburgh.

John S. Unger, Gas Engineer, Dies in Chicago Office

JOHN S. UNGER, Chicago gas engineer and ammonia specialist, passed away suddenly on February 25, 1938, while sitting at his desk in his office. Until the day of his death he had been well and active.

Although 80 years of age, Mr. Unger's interest and activity in his work were unabated. In recent months he had been designing apparatus for producing gasoline as a by-product in the manufacture of oil gas.

Graduated from the Politechnician College of Troudhjem, Norway. in 1878, as a Mechanical and Chemical Engineer, Mr. Unger came to the United States in 1879 to settle permanently. He established himself as a consulting engineer in Chicago in 1907, specializing in gas works construction, especially in the building of ammonia recovery apparatus, in which field he had several valuable patents.

■ ■

Lewis M. Parsons Has New Appointment In Steel Corp.

Lewis M. Parsons, newly elected vice-president in charge of sales and a director of the Jones and Laughlin Steel Corp., Pittsburgh, Pa., on March 1 took over entire charge of all sales activities for the company, including district sales offices in cities throughout the country. Mr. Parsons was formerly manager of sales for the concern's Philadelphia office.

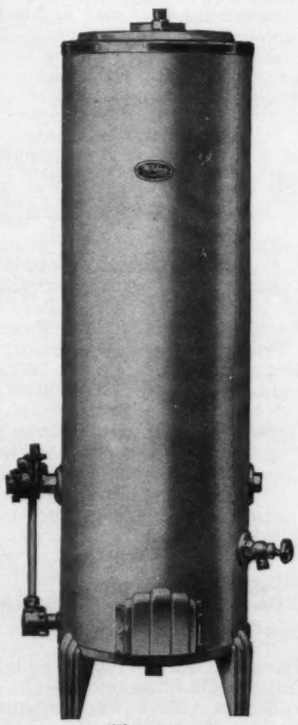
WATER HEATING offers you your most immediate and consistent load-building opportunity.

Many gas companies are capitalizing on this by featuring HOTZONE WATER HEATERS . . . because these heaters give perfect service.

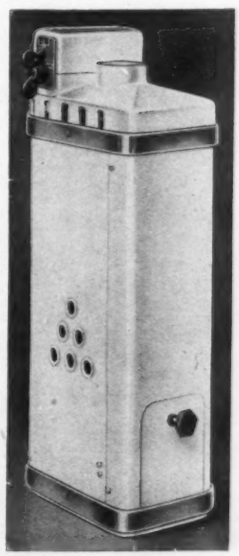
HOTZONES utilize the luminous flame burner with 100% safety shut-off. They offer a type and size to meet every domestic hot water service requirement. And, of course, they have beauty appeal!

HOTZONE CONVERSION HEATER is ideal . . . for modernizing existing storage tank installations in average-income homes . . . it provides full automatic hot water service at low cost. Absolutely silent in operation. An excellent campaign stimulator. Ask for details!

HOTZONE STORAGE HEATERS make the ideal installation for new, modernized and old homes which want the best automatic hot water service at lowest operating cost. They quickly demonstrate the superiority of gas . . . because of unfailing dependability and ability to perform *smoothly* and *efficiently* under all conditions. Ask for details!



Hotzone Storage Water Heater



Hotzone Conversion Water Heater

Welsbach Company

Gloucester City, N. J. Branches—Chicago, San Francisco

Profitable DITCHING

with Barber-Greene's

Barber-Greene's Superior features: the Vertical Boom, Milling Action digging, Automatic Overload Release, Self-Cleaning Buckets and many others give profitable digging. They bring results like 7c a foot for a Washington Water Department (partly through hardpan) . . . 5c a foot for a Texas Gas Company . . . 2½c a foot for hundreds of miles of pipe-line trench. Send a card for the new Barber-Greene Catalog on the 4 B-G Vertical Boom Ditchers. There is no obligation.

Standardized Material Handling Machines

BARBER GREENE

660 WEST PARK AVE.
AURORA, ILL.

36-15

GAS VENTS

whether erected in concealed or exposed spaces must be properly insulated to insure exhausting of the burnt gases into the outer atmosphere without condensing within the vent or flue.

METALBESTOS
GAS VENT & FLUE PIPE

is not only sufficiently insulated to prevent condensation but its inner PURE ALUMINUM liner withstands the corrosive action of the burnt gases indefinitely.

For your protection and assurance of maximum draft and combustion make sure all pipe and fittings bear this mark.

PATENTED
NO. 2076210

METAL BESTOS

TRADE MARK

for Full Information Write to
Williams-Wallace Co.
160 Hooper St.
San Francisco, Calif.

Executives of American Stove Co. Resign

GEORGE F. Fiske and Thomas Rath, have resigned from their respective positions of treasurer and advertising manager with the American Stove Co., Cleveland, Ohio. Both men have been associated with the company for over 30 years.

In 1902 when American Stove Co. was formed, Mr. Fiske was appointed its first treasurer, which position he has held until the present time. Prior to 1902 he was in the employ of the Clark factory, manufacturers of Vapor stoves. The position of treasurer will be taken over by George E. Baker, who since 1930 has been company auditor. Mr. Baker has been with the stove concern since 1911.

Thomas Rath entered the stove business in 1881 on becoming an employee of the Hull Vapor Stove Co., later the National Vapor Stove Co., Lorain, Ohio. Following the taking over of National Vapor by the American Stove Co. in 1902, Mr. Rath was made manager of the National Stove Co. Division in 1906. Since 1919 he has been in charge of national advertising for the company.

Charles F. Farnham will now assume Mr. Rath's former duties, under the general supervision of S. E. Little. Mr. Farnham has served as assistant to Mr. Rath in the advertising department since 1919.

■ ■

Davis Names Committee for A.G.A.E.M. Convention

Merrill N. Davis, Bradford, Pa., president of the Association of Gas Appliance and Equipment Manufacturers, has announced the appointment of the program committee for the Association's annual convention to be held at The Greenbrier, White Sulphur Springs, W. Va., May 25-27. Committee members are:

John A. Fry, president of the Detroit-Michigan Stove Co., Detroit, chairman; W. J. Bailey, president, Day & Night Heater Co., Ltd., Monrovia, Calif.; F. W. Carter, president, Peerless Manufacturing Corp., Louisville, Ky.; J. F. Donnelly, sales manager, Gas & Electric Heater Co., La Porte, Ind.; L. R. Mendelson, president. Hotstream Heater Co., Cleveland; F. H. Ramage, assistant sales promotion manager, Republic Steel Corp., Cleveland; W. F. Roberts, president, Standard Gas Equipment Corp., Baltimore, Md.; F. E. Sellman, vice-president, Servel, Inc., New York; J. Van Norden, the American Meter Co., New York, and H. A. Wilson, president, the H. A. Wilson Co., Newark, N. J.

■ ■

New Line of Electrodes Offered by McKay Co.

The McKay Co., Pittsburgh, Pa., is now offering a complete line of shielded-arc welding electrodes which are claimed by the manufacturer to be quiet in operation, fast in welding time, produce fine bead appearance, and have greater adaptability per rod.

The makers state that, while the new electrodes are of an improved type, no changes in customary operating practice are required.

In order to produce the improved electrode, the company has a new plant at York, Pa., equipped with newly designed machinery. A group of factory experts have worked on the scientific development of the electrodes.

A folder describing the line of electrodes may be obtained by writing the Pittsburg office of the McKay Co.

■ ■

Gayville, S. D., To Receive Natural Gas With Yankton

With the completion of pipe line construction for bringing natural gas to Yankton, S. D., the town of Gayville, S. D., will be able to procure natural gas service as a result of action of the Gayville town board giving permission to the South Dakota Public Service Co. to distribute there.

The South Dakota Public Service Co. is an affiliate of Sioux City Gas and Electric which with the Northern Natural Gas Pipe Line Co. is building an extension from Vermillion to Yankton this spring. The pipe line will pass near Gayville, which will be the only small town in that section to receive natural gas.

R. H. Garrison of the Sioux City Co. recently announced pipe line construction for Yankton would begin immediately as gas is to be in the Yankton city mains by June, 1938, a month sooner than originally reported.

Yankton voters recently denied an application for a 20-year franchise made by the Yankton Natural Co. The application was opposed by the Sioux City Gas Co. which recently purchased the present Yankton franchise, which has six years to run.

■ ■

Warren A. Norris, Lebanon Valley Gas Co., Dies

Warren A. Norris, president, Lebanon Valley Gas Co., subsidiary of the United Gas Improvement Co., died at his home in Lebanon, Pa., on February 9, at the age of 51. In 1911 Mr. Norris first became associated with U.G.I. as a cadet engineer in the chemical laboratory at Station "A" of the Philadelphia Gas Works. In 1925 he was appointed manager of Lebanon Valley Co., and held the position of president from 1929 until his death.

■ ■

A. G. A. Officials Pre-View New Prudence Penny Film

Jessie McQueen and C. W. Person of A.G.A. headquarters staff, recently previewed the new technicolor Prudence Penny film, released by M-G-M.

Featuring Prudence Penny, newspaper home economist, preparing "Penny's Party," as the picture is entitled, the film has a showing time of 11 minutes and shows closely all food preparation. For added interest, touches of humor have been injected into the picture.

■ ■

Central States Co. Has New Offices in Stigler, Okla.

The Central States Power and Light Co., Tulsa, Okla., has moved the company's Stigler offices to new quarters in the Sigmon building, C. V. Cluen, local manager, announced recently. The new offices have been redecorated for the gas company.

Royal Equipment Co. Enters Forced Air Heating Field

ROYAL Air Conditioning Equipment Co., has entered the forced air gas heating equipment field and located plant and offices at 1900 No. Alameda Blvd. Compton, Calif. The new unit is known as the Race Winter-Summer Air Conditioner. Production was begun March 24.

The company was organized by Max Schwartz, J. H. Moore and George J. Henderson, all of whom have been connected with the manufacture and sale of gas-fired heating equipment for the past 25 years. W. H. Stewart is in charge of production.

The present Race line consists of nine sizes of central forced air heating units, ranging in capacity from 90,000 to 630,000 B.t.u. input. Race units are adaptable to any type installation—basements, closets, back porches or other unused spaces. The complete line is also made in commercial models for stores, churches, schools, lobbies, factories and other large industrial enclosures. The line is also available with special equipment for use on butane.

All parts going into Race units, with the exception of the controls, are manufactured in the company's plant. One of the features of Race equipment is the removable heating element, which features permits of the manufacturer's 10-year guarantee against burning out or rusting out of the element. This is a new design of air channel multi-fin element. Other features include built-in down draft diverter, automatic shut-off pilot, double rubber-mounted electric motor, balanced multi-blade blower wheel, cushion-mounted self-aligning bearings and cold air return with removable filters. Race units leave the plant as complete, packaged units ready for installation.

■ ■

Duke and Olustee, Okla. To Get Natural Gas Soon

Consolidated Gas Utilities Corp., Oklahoma City, Okla., is now contemplating plans for furnishing natural gas to Duke and Olustee, Okla., in the near future, according to L. T. King, company auditor. When the company starts furnishing gas to the two towns, a new step rate will be put into effect.

Gas service will be available as soon as the river crossing is completed and necessary repairs are made to the line from Lawton, Okla.

■ ■

Samuel E. Miller Retires

Samuel E. Miller, secretary and treasurer of the Monongahela West Penn Public Service Co., Morgantown, W. Va., since 1929, recently retired after more than 20 years of service. Mr. Miller's retirement was due to ill health.

Succeeding Mr. Miller are Gary J. Jackson, formerly assistant secretary, as secretary and O. F. Lough, vice-president, as treasurer. Appointments were made by the Board of Directors.

GAS *scores again!*

ABC Circulation Statements for December 31, 1937 again prove that GAS is the fastest-growing magazine covering the Gas Industry. As compared with ABC Circulation Statements for December 31, 1936:

GAS *Gained* 492 subscribers

GAS AGE *Lost* 1029 subscribers

AMERICAN GAS JOURNAL *Lost* 18 subscribers

In the last 5 years, the circulation of GAS has increased 36.6% without any increase in advertising rates. During this same period, the advertising pages in Gas have increased 125.6%. Real proof that advertisers know that GAS is the biggest "buy" for covering the Bigger Half of the Gas Industry.

GAS Total Distribution (6 mo. average A.B.C.) 4,121 Copies per mo.

ABC GAS ABP

The NATURAL *Gas Magazine*

Start your campaign with the Annual Natural Gas Edition

Forms close April 15, 1938

810 South Spring Street, Los Angeles

MUELLER GAS DISTRIBUTION EQUIPMENT

The time-tested Mueller line includes Mueller Evenflow Service Regulators, Gas Stops, Service Stops, Stove Stops, Drilling and Tapping Machines, service boxes, meter trims and similar equipment. Write for description and prices.

MUELLER CO., Los Angeles, Calif.

Factories: Decatur, Ill.; Chattanooga, Tenn.; Los Angeles, Calif.; Sarnia, Ont.
Branches: New York and San Francisco

BUILD LOAD WITH *Satisfied* CONSUMERS*

* The BEST way to assure *complete* consumer satisfaction with gas as an economical fuel is to recommend an inspection of the COMPLETE LINE OF

PACIFIC GAS HEATING APPLIANCES

THERMOLATORS	CENTRAL BLOWER FURNACES
RADIANT CIRCULATORS	INDUSTRIAL UNIT HEATERS
WALL HEATERS	FORCED-AIR UNITS
RADIANT HEATERS	WATER HEATERS
FLOOR FURNACES	
GRAVITY FURNACES	

Pacific
GAS RADIATOR CO.
1740 W. Washington Blvd., Los Angeles, Calif.
Manufacturers of the Most Complete Line of Gas Heating Appliances in the West

Pacific Multi-Tubular Burners Set a New High in Gas Heating Economy and Efficiency. Orifices Precision Drilled at Factory to Assure Perfect Combustion Permanently.

Gas and Electric Appliance Dealers Meet In New York

MEETING in the auditorium of the Consolidated Edison Co. of New York, Inc., on the evening of March 8, more than 1200 gas and electric appliance dealers were present to hear discussion of a three months promotion program, including automatic refrigeration, gas house heating, gas water heating, and gas laundry dryers. Details of the campaign were presented by E. F. Jeffe, vice-president in charge of sales, and twelve other speakers.

Scheduled to begin April 1, the proposed sales activities will be undertaken by the System Companies in cooperation with approved appliance dealers in Manhattan, Bronx, Brooklyn, Queens and Westchester. The coming campaign will be in addition to and will tie-in with the special appliance program involving eight appliances which began in March and will run through May.

Henry Obermeyer, assistant vice-president in charge of advertising, Consolidated Edison, announced in his address to the meeting that the company was using two advertisements featuring each appliance each month in metropolitan newspapers and one insertion per month of a group advertisement in full color in the color supplement of a metropolitan Sunday paper. The eight appliances are also to be featured in 22 foreign newspapers every month, on the company's radio program, and in 214 24-sheet billboards.

■ ■

A.G.A. Sponsors Gas Laundry Drier In Promotion Drive

The Management Committee of the American Gas Association has made the gas-heated laundry drier the fifth of the major domestic appliances, now known as the "Big Four," to be sponsored by the association in its national sales promotional campaign. Final specifications for A.G.A. Laboratory approval have been formulated, and it is hoped that laundry drier promotion will result in the opening of another large potential market for gas.

■ ■

Safety Gas Main Stopper Co. Resumes Business In N. Y.

Francis Greer Goodman and Elizabeth A. Goodman, manufacturers and distributors of gas main stoppers, distribution equipment, and pipe line supplies, last month resumed business under the firm name of Safety Gas Main Stopper Co., Brooklyn, N. Y. The new concern is a successor to the corporation of the same name which was recently voluntarily dissolved.

■ ■

Ohio Fuel Gas Co. Has New Quarters in Willard, Ohio

Neil McCaron, manager of the Willard, Ohio, headquarters of the Ohio Fuel Gas Co., recently announced that new Willard offices have been leased in the W. C. Miller building. Before moving the gas company will install a heating system and build partitions for offices and sales room in the new quarters.

HIGH CAPACITY—SMALL SIZE!
LOW PRESSURE REGULATORS

Built in THREE Sizes

½" Size	Small ¾"	Large ¾"
Capacity	Capacity	Capacity
90,000 BTU	115,000 BTU	150,000 BTU
Dimension	Dimension	Dimension
5" Overall	5" Overall	6" Overall

Exceptional high output—perfect regulation at all pressures—low lockup. A small size—low cost regulator with highest capacities for all types of gas appliances.

AGA—LISTED
Write for more information.

The H. M. Thermo Control Co.
814 E. 108th St. Los Angeles, Cal.

STANDARD PRODUCTS
THAT ARE *Kitson Standard*

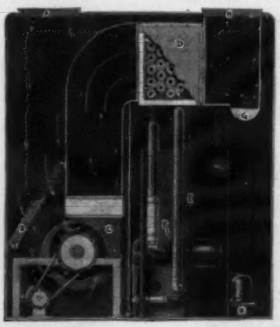
Made from finest Quality Metals, carefully machined to exacting specifications. Each thoroughly tested, before leaving the factory, for ease of operation and freedom from leakage.

G-501—Flathead Iron Body Brass Plug Gas Stop

KITSON COMPANY
2409-15 Westmoreland St. Philadelphia, Pa.

C. A. Dunham Co. Announces Booklet On Air-Conditioning Lines

THE C. A. Dunham Co., Chicago, Ill., announces the publication of a booklet, "Reduce the Waste Line in Heating Your Home," which is devoted to a description of its home heating-Sav-T-heat equipment. This heating and air-conditioning unit is produced in three types, the warm air comfort conditioning system, the vapor radiator system, and the split system, which is a combination of the first two types.



The warm air system shown in the accompanying diagram consists of a generator (which replaces the boiler or furnace), a heat exchanger, an exhauster, air vent, filter, humidifier, all housed within a streamlined housing, finished in grey, orange, and a stainless steel trim.

The combustion of gas takes place in the generator (E). The product of this combustion is drawn by the exhauster into a chamber where the hot gases are mixed with water to form a gas vapor. This vapor contains practically the same B.t.u. content as the hot gases, but is much cooler. The gas vapor travels into the copper heat exchanger (D), where it delivers its heat. The cooled gases, after leaving the heat exchanger, are vented to atmosphere through a two-in. copper pipe.

The unheated air which is to be conditioned, enters the unit at point (A), travels through filters (B) and fans at (C) and is directed through the heat exchanger (E) into the ducts of the system. But before thus passing into the system, the moisture content is regulated at point (G) by a balanced damper.

■ ■

Buckingham Palace Kitchens Use Gas to Cook King's Meals

The King of England eats gas-cooked food! Here are the facts about the kitchens at Buckingham Palace, as supplied by T. W. Coghlin, publicity officer, The British Commercial Gas Association:

Of the two kitchens at the Palace, one is all gas, and two more large gas cookers have been ordered for it. The other kitchen is part gas, part solid fuel.

Gas is also used to light all outside lamps at the Palace, and emergency gas lighting has been installed in the throne room, the picture gallery, the supper room, and other parts of the Palace.

In York House, St. Jame's Palace, recently renovated for the Duke and Duchess of Gloucester, a gas kitchen has been installed. Water heating is by gas and coke, and some modern gas fires have been fitted.

■ ■

Worthington Pump Issues Bulletin On Four-cycle Vertical Gas Engines

Worthington Pump and Machinery Corp., Harrison, N. J., announces the publication of an eight-page bulletin, S-550-B4C, describing its vertical, four-cycle, type AG gas engines. Directed to power users where natural, manufactured, sewage or refinery gas is available, this bulletin includes complete specifications, together with typical installation views of these engines.

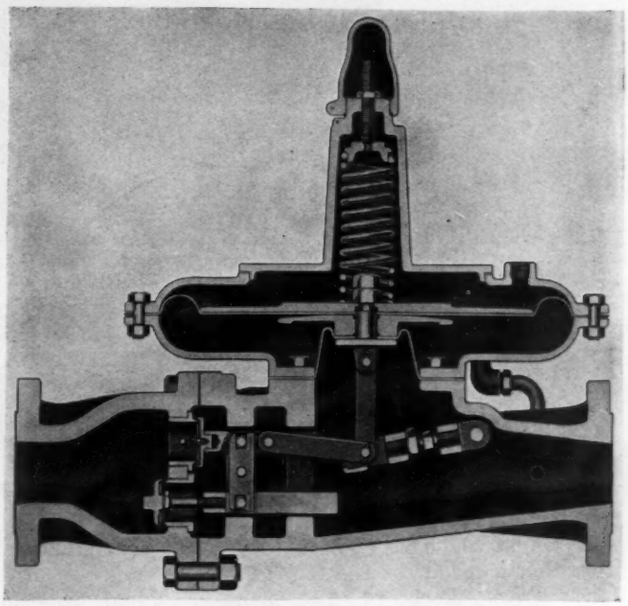
An interesting sectional drawing illustrates the features of the engine among which are valve-in-head construction, total enclosure of all moving parts, removable cylinder liners, separate water-cooled cylinder heads, light-weight, oil-tight covers for crankcase accessibility, and complete force-feed lubrication.

■ ■

Dr. H. N. Davis Visits Pacific Coast

Dr. Harvey N. Davis, president of the Stevens Institute of Technology, Hoboken, N. J. visited the west coast last month to preside over the national convention of the American Society of Mechanical Engineers which convened in Los Angeles, March 23-25. Dr. Davis was the guest of A. B. Macbeth, president of the Southern California Gas Co. and a director of the Stevens Institute.

Industrial
GAS CONTROL



Cross-Section — Reynolds Spring Type, Double Valve, Toggle Type, Flanged Regulator for Industrial Use

REYNOLDS Toggle Type Regulators for industrial gas control offer these features:

Removable Valve Pocket and Orifices—side hand holes—streamlining that does not change direction of the flow of gas, increasing capacity and range—*pressure reduction from pounds to pounds and pounds to inches W. C.—single or double valve construction—spring or dead weight type adjustment and equipped with or without pilot control.

Regardless of how unusual or difficult the requirements, there is a REYNOLDS engineer ready to give you the correct answer. Many manufacturers who desire greater safety and accuracy on their products regularly consult with our Engineering Department. The same service is yours for the asking—write.

*Body of Regulator is so machined that a pounds to pounds diaphragm casing or a pounds to inches W. C., diaphragm casing may be used or interchanged.

BRANCH OFFICES:
421 Dwight Bldg.
Kansas City, Mo.
Second Unit
Santa Fe Bldg.
Dallas, Texas

REPRESENTATIVES:
Eastern Appliance Company
Boston, Massachusetts
William A. Ehlers
East Orange, New Jersey

REYNOLDS GAS REGULATOR COMPANY
Anderson, Indiana, U. S. A.

Recognized Gas Control Since 1892

In attendance at the Southern California cooking demonstration given by E. C. Sorby of the George D. Roper Corp. were James Beverage, Roper Corp.; Mr. Sorby; W. M. Jacobs and A. F. Rice, Southern California Gas Co.; Lucille Silver and T. H. Hall, Roper Corp.; Gladys Price, F. M. Banks, J. E. Kern, and R. V. Davis, So. Calif. Gas Co.

Roper Performance Demonstrated on Pacific Coast By E. Carl Sorby

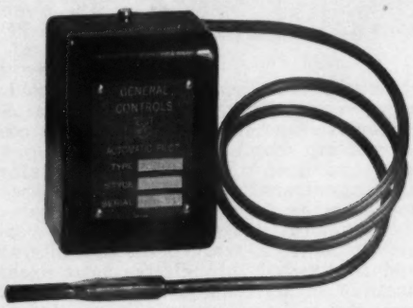
NOT what the gas range is, but what it will do—that is the principle on which E. C. Sorby, sales promotion manager of the George D. Roper Corp., Rockford, Ill., manufacturers of the Roper Range, bases his demonstration, in modern gas cookery. Mr. Sorby has just completed a series of demonstrations on the Pacific Coast, and is at the present time in Salt Lake City preparatory to continuing his series throughout the midwest area.

Final demonstration in Southern California was given March 17 at the home office of the Southern California Gas Co. in Los Angeles with T. H. Hall, southern California manager of the George D. Roper Corp. in charge. The demonstrations presented in Mr. Sorby's unique, dramatic and humorous manner, attracted over 1000 Southern California appliance dealers and utility sales executives.

■ ■

General Control Co. Makes New Pilot Control

The Thermopilot, a new automatic pilot control, is announced by the manufacturers, the General Controls Co., Chicago. This new control utilizes the thermocouple principle of operation. When the flame is applied to the thermocouple element, contact is made, allowing the main gas valve to open. Should the pilot light fail, the Thermopilot automatically opens the circuit and the gas valve closes; automatically resets itself when the pilot is relighted.



The thermocouple tube is very flexible for easy installation. Two or three-wire control. Complete information may be had by writing the General Controls Co., 450 East Ohio Street, Chicago, Ill.

■ ■

Production of Refrigerator Postponed by Chicago Firm

General Household Utilities Co., Chicago, has announced that it will not place its new product, the Carrene Thermene Refrigerator on the market at this time, according to a letter of March 1 from H. Alter, president of the firm. This alteration in the company's plans comes as the result of a survey of existing business conditions.

■ ■

H. J. Smith Loses Home In So. California Flood

H. J. Smith, president, Ward Heater Co., has lost his Malibu Beach home, garages, two automobiles, furniture, and clothing, as a result of the recent Southern California flood disaster. In the middle of the night of the flood, Mr. Smith, his wife, and three children, were forced to leave their home as the flood waters wreaked their destruction. The following day Mr. Smith went out in a boat to search for his belongings and succeeded in reclaiming some clothes from the water.

■ ■

Ohio Fuel Gas Co. Moves to New Office in Mt. Vernon

The Ohio Fuel Gas Co., Columbus, Ohio, recently moved its Mt. Vernon office to new quarters on the east side of the public square.

The Goodman Stopper

The Reliable Shut-off for Street Mains

Equipped with Improved Patented Locking Sleeve, which locks both handles to the pipe. Stopper cannot slip. **Gas cannot pass.**

Safety Gas Main Stopper Co.
523 Atlantic Avenue, Brooklyn, N. Y.

Pac. Coast Rep.: C. B. Babcock Co.
475 Eleventh Street
San Francisco, California

Electrogas
FOR EVERY HEATING NEED
FURNACES
BLOWERS
FILTERS
WASHERS
Air Conditioning • Heating Equipment
WRITE FOR ATTRACTIVE DEALER PROPOSITION
ELECTROGAS FURNACE CO. 2575 BAYSHORE BLVD. SAN FRANCISCO, CALIF.

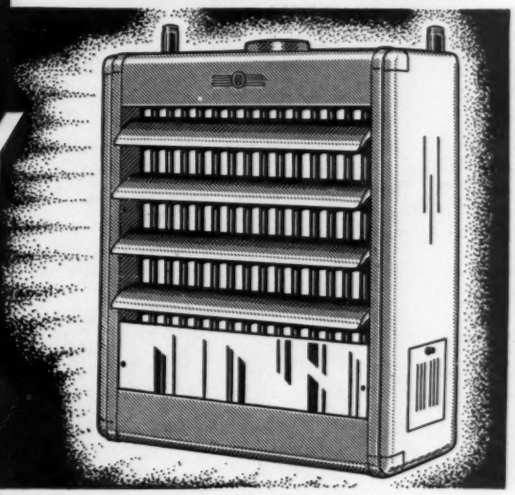
HEAT

FOR FACTORIES • RETAIL STORES • GARAGES SERVICE STATIONS

The Modern

HUMPHREY *Gas Unit* HEATER

FORCED CIRCULATION HEATING



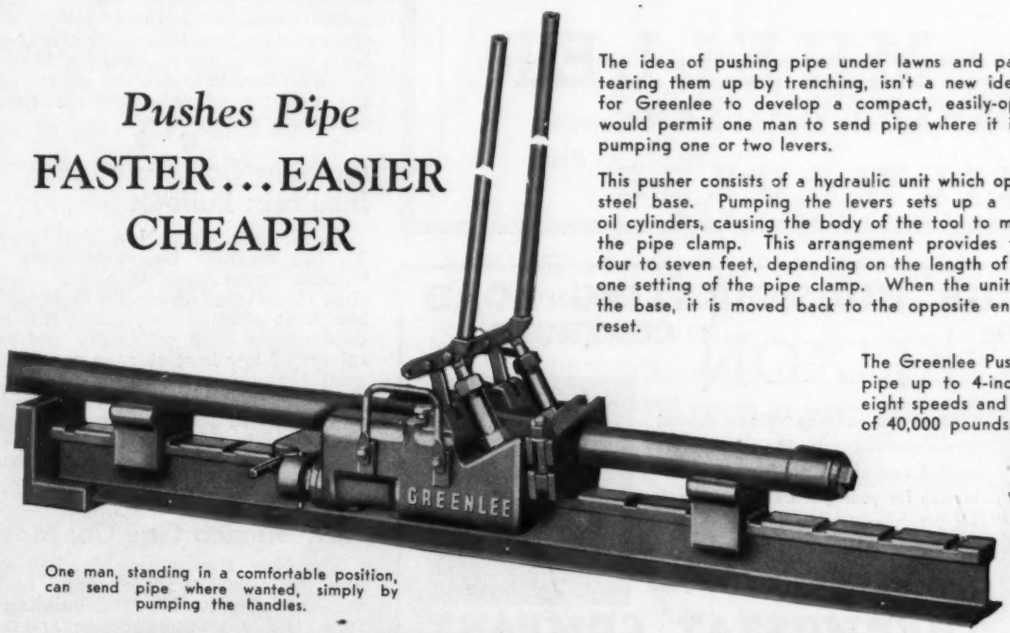
A HUMPHREY PRODUCT

COMPLETELY modern in design and finished to blend harmoniously with the interior decorations of the smartest retail shops, the new Humphrey Gas Unit Heaters can do a surprisingly good job for you this year in boosting gas loads. They offer the industrial plant, retail store, garage, and service station a quick, dependable source of heat without a huge investment in equipment. How to sell such establishments is clearly demonstrated in our new Cooperation in Selling Portfolio. Ask our representative about it or write for your copy.

GENERAL GAS LIGHT CO. KALAMAZOO, MICHIGAN

Use the Greenlee HYDRAULIC PIPE PUSHER and Leave Lawns and Pavements Undisturbed

Pushes Pipe
FASTER...EASIER
CHEAPER



One man, standing in a comfortable position, can send pipe where wanted, simply by pumping the handles.

The idea of pushing pipe under lawns and pavements, instead of tearing them up by trenching, isn't a new idea. But it remained for Greenlee to develop a compact, easily-operated pusher that would permit one man to send pipe where it is wanted, simply by pumping one or two levers.

This pusher consists of a hydraulic unit which operates on a notched steel base. Pumping the levers sets up a pressure within two oil cylinders, causing the body of the tool to move forward against the pipe clamp. This arrangement provides for a push of from four to seven feet, depending on the length of base used, with but one setting of the pipe clamp. When the unit reaches the end of the base, it is moved back to the opposite end, and the clamp is reset.

The Greenlee Pusher has capacity for pipe up to 4-inch, is provided with eight speeds and will exert a pressure of 40,000 pounds on the pipe clamp.

WRITE NOW for COMPLETE DETAILS

GREENLEE TOOL CO., 1700 Columbia Ave., ROCKFORD, ILLINOIS

Annual Gas Section Convention Held By Wisconsin Utilities Last Month

FRANK WILKINSON, gas superintendent, Northern States Power Co., La Crosse, Wis., and Charles G. Grau, manager, Oneida Gas Co., Rhinelander, Wis., were elected chairmen, respectively, of the Technical and Commercial Divisions of the Gas Section of the Wisconsin Utilities Association at the closing sessions of the section, held in Milwaukee, March 16-18. Mr. Wilkinson succeeds E. C. Brenner of the Milwaukee Gas Light Co., while Mr. Grau succeeds himself.

Attendance at the three day meeting totaled 239 delegates registered, and approximately 300 people present.

The program for the conference was planned by 54 gas men, members of committees of the section. The Technical Division had charge of the first morning's program which was a joint session with E. C. Brenner presiding. Charles G. Grau presided at the first afternoon meeting. During the joint session papers on sales promotion and advertising were presented.

After the first day the two divisions met separately, each group devoting two afternoons to round table discussion. Papers presented at the morning Commercial Division meeting dealt with appliance sales, new promotion programs, and home service. Subjects presented in the morning technical meetings included: gas conditioning, holder heating, pressure regulation, reverse flow water gas machine operation, and many others.

C. G. GRAU

FRANK WILKINSON

Officers, other than division chairmen, named at the convention, were: G. A. Anderson, Sheboygan, gas superintendent, Wisconsin Public Service Corp., as vice chairman of the Technical Division; and A. A. Zertler, Marshfield, manager, Peoples Gas Co., as vice chairman of the Commercial Division.

Officers of the Wisconsin Utilities Association are: president, C. E. Kohlhepp, Wisconsin Public Service Corp., Milwaukee; vice-president, Bruno Rahn, Milwaukee Gas Light Co., Milwaukee; treasurer, J. J. Dropp, Milwaukee Gas Light Co., Milwaukee; and executive secretary, A. F. Herwig, Milwaukee.

■ ■

Lukens Steel Co., Pa., Asks For Natural Gas

The Lukens Steel Co., Coatesville, Pa., has asked the Public Utility commission to permit the Manufacturers Light and Heat Co., Pittsburgh, Pa., to furnish it with natural gas.

The steel company needs natural gas in its operations to compete with other manufacturers using that fuel. Lukens Steel is now using fuel oil.

Manufacturers Light and Heat has a transmission line three and a half miles from the firm, but its territory is limited to public service companies chartered for the territory, officials of the Lukens Co. declared.

■ ■

Quigley Co. Announces Insulbrix Bulletin

Quigley Co., Inc., New York City. N. Y., has recently issued an eight page bulletin describing Insulbrix installation. Insulbrix, which are light weight, low heat storage insulating fire brick, combining a high refractory and an insulator of low heat storage capacity, are used for direct exposure to flame and gases, in boiler furnaces, ovens, kilns, and other high temperature equipment. According to the bulletin, Insulbrix, because of this low heat storage capacity, save fuel, time, and labor.

■ ■

New Mexico Gas Co. Moves

The New Mexico Gas Co. has moved into the new $50,000 company building in Santa Fe, N. M. The building will form the operations headquarters for the entire company whose activities extend through New Mexico and the West Texas territory.

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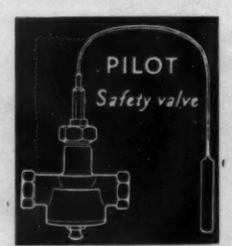

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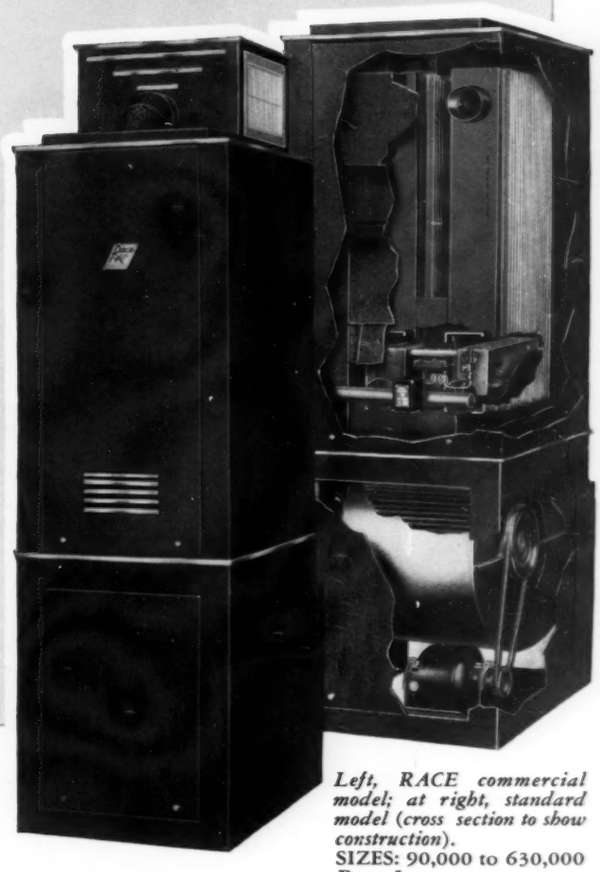

Left, RACE commercial model; at right, standard model (cross section to show construction).
SIZES: 90,000 to 630,000 B.t.u. Input.

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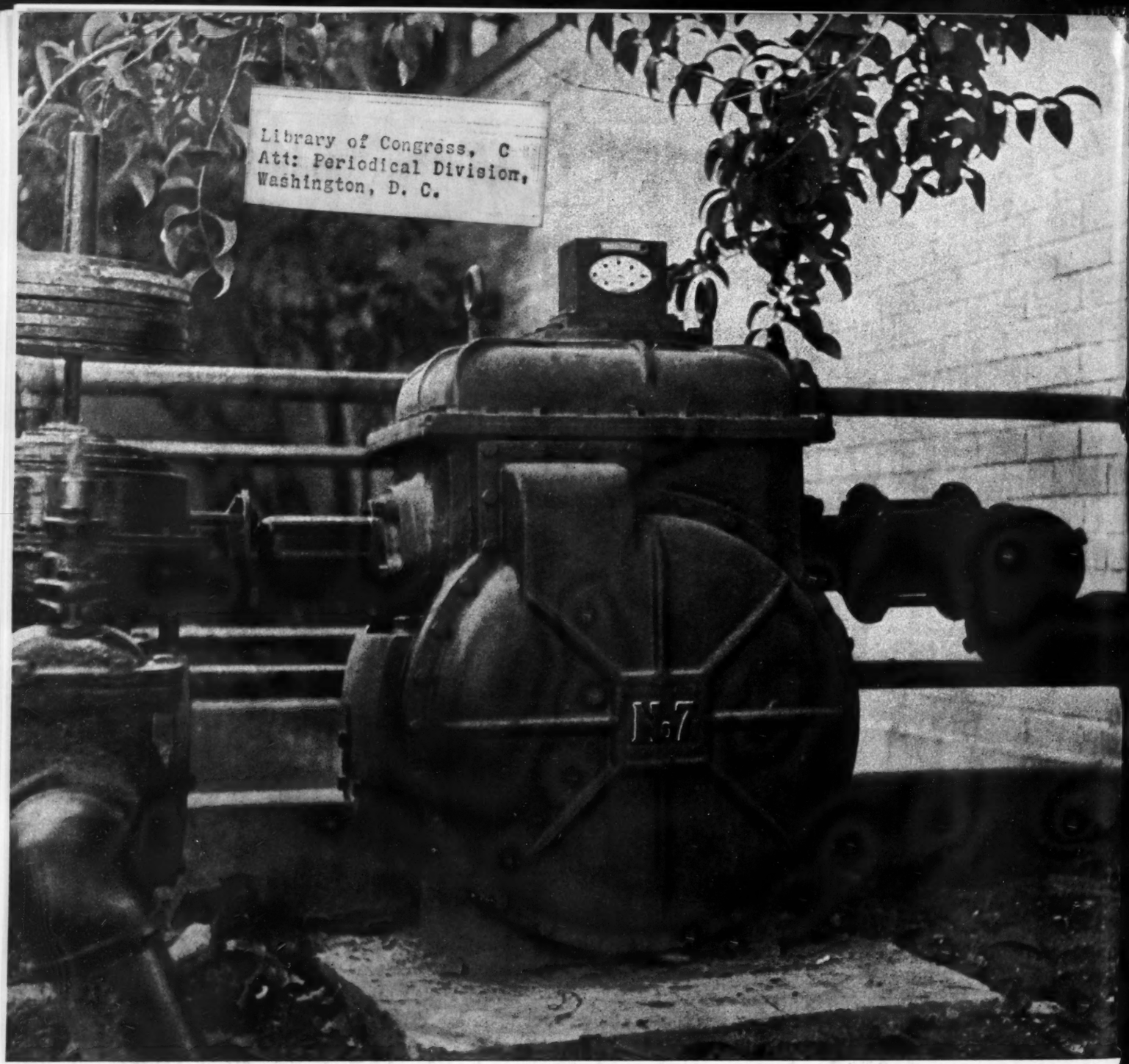

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